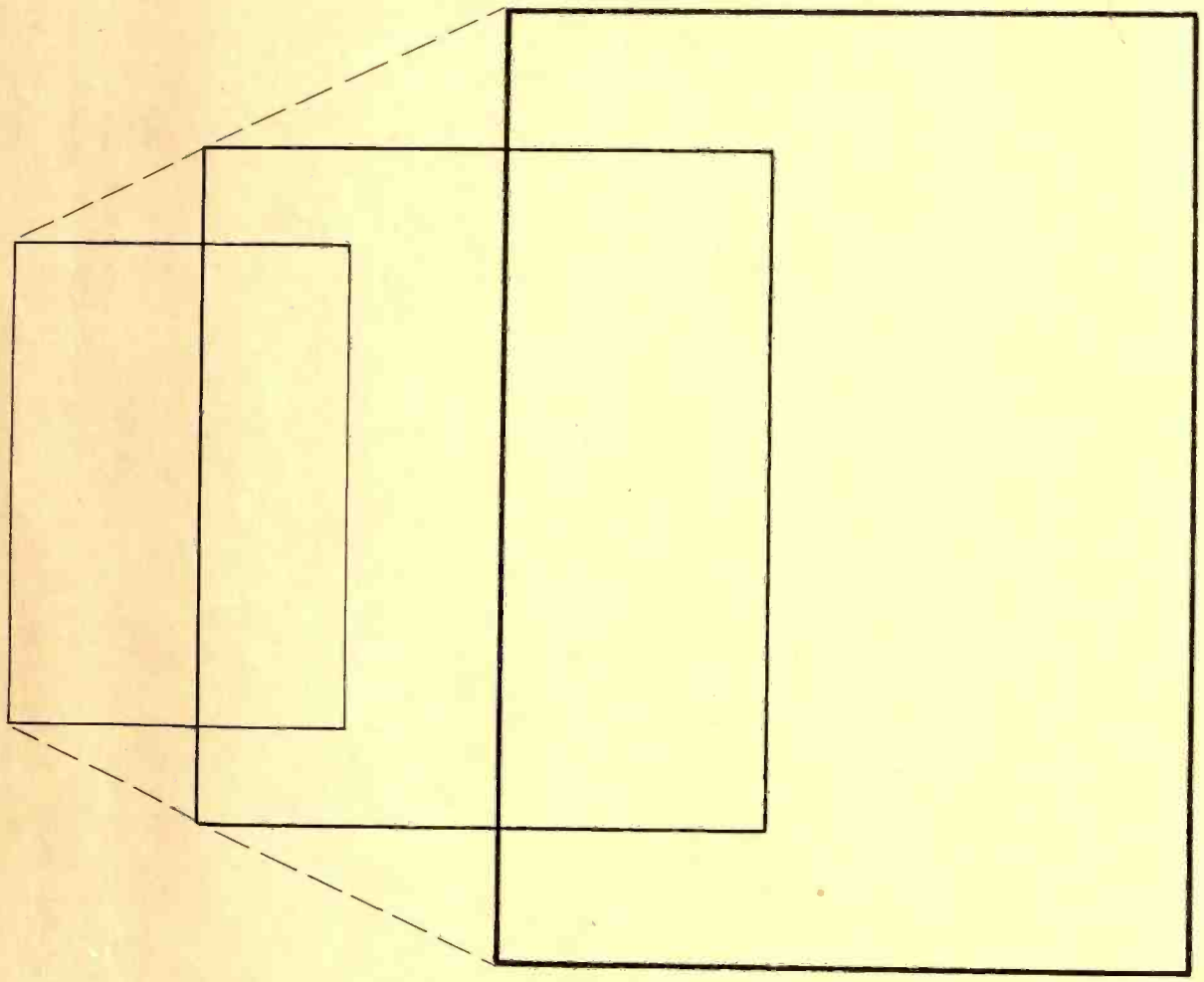
SD565
U45

ROCKY MTN. FXPT. STA. L
FLAGSTAFF FIELD COPY
REFERENCE NO. 90

ROCKY MTN. FXPT. STA. LIBRARY
FLAGSTAFF FIELD COPY
REFERENCE NO. 90

SIZE OF RANGER DISTRICT STUDY



Forest Service - U.S. Department of Agriculture

Washington, D.C.

October 1968

LIBRARY COPY
ROCKY MTN. FOREST & RANGE
EXPERIMENT STATION

SIZE OF RANGER DISTRICT STUDY

Frank C. Bell
Walter L. Graves
Malcolm W. Kirby
Kenneth P. Norman
Gideon Schwarzbart
Ernst S. Valfer

LIBRARY COPY
ROCKY MTN. FOREST & RANGE
EXPERIMENT STATION

AUTHORS' BIOGRAPHIES

FRANK BELL is the principal management analyst of the Management Sciences Staff of the Forest Service, Berkeley, California, where he has been participating in organizational and PPBS studies since 1966. He has been a forester with the Forest Service in Region 3 since 1952, holding assignments as District Ranger, Forest staff, and Timber Management staff at the Regional level. Before his Forest Service employment, his experience includes accounting and extensive business management activities. A forest management graduate from the Colorado State University (B.S. 1952), he also took business courses at the University of Kentucky.

WALTER L. GRAVES is Assistant Regional Forester in charge of the Division of Operation in Region 3, Albuquerque, New Mexico. In his 34 years with the Forest Service, Mr. Graves has been a District Ranger, a Forest Supervisor, and has held staff positions in the Regional and Washington Offices. Before becoming an Assistant Regional Forester in 1961, he was for 5 years Chief of the Planning and Emergency Programs Branch in the Division of Administrative Management, Chief's Office, Washington, D.C. While there, he developed, in 1957, the existing policy on the size of Ranger Districts and served on the task force which developed in 1959 the "Organization Study of the Forest Service." He is a forestry graduate (B.S. 1933) of Iowa State University.

MALCOLM KIRBY is the principal industrial engineer of the Management Sciences Staff. Joining the staff in 1962, he has guided analytical studies in equipment management, systems design, and Planning-Programing-Budgeting. Previous to Forest Service employment, he was a research analyst for the National Academy of Sciences-National Research Council, and an engineer for Aerojet General Corp., Kaiser Engineers, and others. He holds bachelor's degrees in business (1954) and industrial engineering (1956), and a master's degree in operations research (1964), all from the University of California, where he is now completing work for a doctorate in operations research.

KENNETH P. NORMAN is a Branch Chief in the Division of Watershed Management, Region 5, San Francisco, California. Until 1966, he was the Deputy Forest Supervisor of the Plumas National Forest in California. His 17 years' experience with the Forest Service includes 4 years as a staff officer in a Forest Supervisor's office in Region 3, and 5 years as a District Ranger in Region 5. He earned bachelor's (1950) and master's (1951) degrees in forestry at the University of California, Berkeley.

SD565
U45

GIDEON SCHWARZBART is the principal statistician of the Management Sciences Staff, and consultant on mathematical statistics for the Pacific Southwest Station, Berkeley, California. He has conducted studies in problems of growth response surfaces, communications systems design, organization, and the general field of biostatistics. His undergranduate work was in forestry and mathematics at Michigan State University (B.S., 1955). Graduate degrees are in mathematics (M.S., 1956) from Michigan State University, and in biostatistics (Ph.D., 1965) from the University of California, Berkeley.

ERNST S. VALFER is Chief of the Management Sciences Staff of the Forest Service. The staff is responsible for Service-wide management systems analysis. Before joining the Forest Service in 1962, he was a study director for the National Academy of Sciences-National Research Council, and chief industrial engineer for the Alameda Naval Air Station. He holds degrees in general and industrial engineering (B.S., 1950; M.S., 1952) and a Ph.D. in engineering sciences and industrial psychology (1964) from the University of California, Berkeley, where he also serves as a lecturer in socio-technical systems in the College of Engineering.

CONTENTS

Authors' Biographies ii

PART ONE

I. INTRODUCTION

A. Size and Effectiveness 1
B. The Forest Service Organization 2
C. The Ranger District 3
D. Organizational Concepts 4
E. The Size of Ranger District Study 5

II. SUMMARY OF FINDINGS

A. Factors Contributing to District Effectiveness . . . 8
B. Size-Effectiveness Relationship 9
C. Size of Existing Districts and Future Trends 12

III. RECOMMENDATIONS

A. On Size of District 14
B. On District Personnel Management 14
C. General 15

IV. APPLICATION OF RESULTS

A. General Considerations 16
B. Service to the Public 16
C. Quality of Resource Management 17
D. Costs 18
E. Organizational Management 18
F. Priorities 18

PART TWO

V. METHODOLOGY

A. Study Design 20
B. Measures 29
C. Methods of Analysis 41

VI. ANALYSIS AND FINDINGS

A. District Characteristics Related to Effectiveness. . 50
B. Effectiveness Relationships 52
C. Validity of Measures of Effectiveness 83
D. Simulation 84
E. Field Study Findings 97

Literature Cited 107

I. INTRODUCTION

A. SIZE AND EFFECTIVENESS

Popularly an organization's size is often identified by the number of employees or management levels, the floor area of the plant, investment in facilities, assets, annual output, sales or revenue, expenditure or budget. But these size measures by themselves give few clues for subdividing the total complex for administrative management and control.

Like Noah in biblical times, most early administrators made their organizations as large as the market allowed, constrained only by capital, labor and transportation. Until the 1900's, this procedure posed no administrative problem, since the owner, plus one or two assistants, easily managed the whole activity. As organizations grew in "size" and complexity, subdivisions were made intuitively along technologically defined boundaries by grouping similar machines, processes, skills, or products under a single administrator. When these technological subdivisions became unmanageable, industry began to consider the administrative limitations of man.

The number of people who can be effectively managed and supervised by an administrator--often called "span-of-control"--became the guiding theory for the administrative structuring of modern industrial organizations. The span-of-control concept was already known in biblical times, as Exodus (2) and by early military commanders. In the 1900's, writers began developing an extensive theory to support it, including mathematical formulae for calculating personal interactions (18), appropriate levels of organization (7,9) and the consequent communications efficiency (15).

Other recent bases for organization sizing are "non-delegable work" (20), the work which an administrator must perform himself. This work is a function of organization size and of the "span-of-discretion" concept by Elliot Jacques (8). The most recent organization theory useful to organization size planning is the "socio-technical systems" framework in which social interaction, work patterns, and job content are evaluated according to the technological requirements of the tasks and productions (6,16).

The study reported in this paper took the socio-technical systems framework as a reference, but attempted to tie organization size more directly to the consequences of size on organizational effectiveness. The obstacle here is that organizational effectiveness has so far defied an adequate theoretical, and even more, a usable definition (13). Most often, researchers will select one or more organizational behavior variables, assumed to be dimensions in the amorphous concept of effectiveness, and test their sensitivity to other variables. For example: productivity and internal survival of an organization are often assumed to be sensitive to leadership style and employee attitudes (10,12).

Other attempts to describe organization effectiveness use subjective evaluations by managers of an organization's performance along specified dimensions or in an over-all rating (19). Mahoney (13) suggested a total of 150 effectiveness variables which were factored into 24 dimensions dealing with decentralization and style of management which accounted for 58 percent of the over-all performance variance. Another 27 percent of the variance was absorbed by the Performance-Support-Utilization dimensions, and 14 percent by the Planning dimension.

Ties between these relatively vague effectiveness measures and organization size have been studied only meagerly. On the other hand, size of work group and its effects on the social character (e.g. cohesion and leadership) and psychological behavior of its members (e.g. participation in decision-making and goal setting) have been studied extensively (3,17).

Operating cost is another size-dependent variable benefiting from previous studies. The effects of size on such isolated cost factors as the generation, processing and reading of internal mail (1) have been studied. However, the over-all cost of operations, a central effectiveness variable, is not so easy to relate to size. Economies of scale in direct cost of operations are known to exist in varying central size ranges (14) depending on industry. Contradicting results showing negative correlation between output and size (up to 50 people) with an increase in output beyond that size are also reported (3). But no comprehensive size-cost evaluations were found in the literature.

A review of the literature inevitably leads one to agree with Cyert and March (5) that there have been only meager attempts to apply organization theory to organization design. Most researchers prefer to deal with the more prestigious and less limiting phenomena of abstract organization theory, and the manager apparently cannot translate into design principles the weak clues which existing theory provides.

B. THE FOREST SERVICE ORGANIZATION

The Forest Service, an agency in the U. S. Department of Agriculture, administers the National Forest System, which covers some 187 million acres of publicly-owned lands. The Chief of the Forest Service has over-all charge of the National Forest System, which is divided into nine Regions, each headed by a Regional Forester. Each Region consists of several National Forests administered by Forest Supervisors. There are also a number of National Grasslands that, with one exception, are administered as part of a National Forest. In a few cases, two or more National Forests or Grasslands are administered by a single Forest Supervisor. Each National Forest is divided into Ranger Districts, except that some small forests are administered as one Ranger District. Each District is managed by a District Ranger. The Ranger District is the smallest organizational entity of the National Forest System. It constitutes the last of the four organizational levels in the Forest Service. Besides the National Forest System, the Chief

also has responsibility for State and Private Forestry and Forest Service Research programs, but this report is confined solely to administration of the National Forest System.

The over-all mission of the Forest Service is best described in a letter written by Secretary of Agriculture Wilson to the Chief of the Forest Service in 1905. This letter charged the Chief with the responsibility of managing the National Forests for "the greatest good of the greatest number in the long run." The mission, as stated in Secretary Wilson's letter, is as sound today as it was then--more than 60 years ago. Over the years, numerous laws have been enacted by the Congress to clarify or define the responsibilities of the Forest Service in managing the public lands under its administration. None of these laws has materially altered the objective expressed by Secretary Wilson, but rather have served to emphasize the need to manage the National Forests so as to insure continued availability of their natural resources for present and future generations. The Multiple-Use Sustained Yield Act of June 12, 1960, provides direction for the management of lands administered by the Forest Service. It directs that National Forest lands be managed for effective use of all available natural resources rather than be restricted to the use of a single resource.

C. THE RANGER DISTRICT

The Ranger District is the foundation on which the entire structure of the National Forest System rests. It is here that the management and use of the natural resource takes place. The condition of these resources is largely determined by the ability of the District Ranger and his staff to maintain a proper balance among the various uses and to determine the degree to which any one resource should be used. Natural resource uses found on Ranger Districts consist of timber harvesting, livestock grazing, mining, oil and gas drilling, hunting and fishing, water production, and recreation. One or more of these uses may be lacking on any one District, but in general, they are found in varying degrees on most Districts. In addition, to the resource uses, there are supporting activities, such as fire control, forest insect and disease control, construction and maintenance of roads and trails, structural improvements of all kinds, land exchange, and special land uses. The skills needed on most Ranger Districts are many and varied to manage adequately and coordinate efficiently the uses of natural resources.

On each Ranger District, the responsibility for management of all activities is clearly and definitely assigned to one person--the District Ranger. He may delegate some of his authority and related responsibility to his subordinates, but he may not subdivide his District. Nor can he delegate responsibility for all activities within a sub-unit to a subordinate.

When the first Ranger Districts were established--some 70 years ago--the District Ranger was primarily a custodian. Demand for and use of the natural resources was light and consisted mostly of harvesting timber and grazing of livestock. The Ranger's responsibility was mainly to control fires, mark timber, insure that livestock grazed did not exceed permitted numbers, and maintain trails. The Nation's population was relatively sparse, and there was practically no need to manage intensively for recreation,

water production, or wildlife. At that time, the area assigned to a District Ranger was usually determined by the amount of country he could cover on foot or horseback once or twice during the year. And he usually had no help except possibly a few seasonal workers.

As the Nation's frontier was pushed further west by railroads and roads, populations expanded and the demand increased for more and more use of the National Forests and their resources. During the Civilian Conservation Corps (CCC) Program in the 1930's and early 1940's, there was a ground-swell of activity on Ranger Districts. Roads were built, recreation sites developed, and many improvements of various kinds constructed. But not until after World War II did increasing demands for forest products and pressures of public use begin to make themselves strongly felt. And activities on the Ranger Districts began to increase rapidly. The result was a shift in the responsibility of the District Ranger from custodial to intensive resource management. The public began to take an active interest in the management of public lands. And the way these lands were managed came under close scrutiny by both organized groups and individuals. Demands for resources previously considered as relatively unimportant began to increase and skills never before considered as essential to resource management suddenly became a necessity. As an example, only in recent years has watershed management assumed major importance. Always before, it was felt that if the other resources were properly managed, water would take care of itself. Today, it is recognized that watershed management involves much more than this if an adequate, sustained supply of good quality water is to be assured.

In addition to steadily increasing demands for use of National Forest lands, many other programs have developed which require participation of the District Ranger. Civil Defense, the War on Poverty, Rural Area Development, and Area Redevelopment are some examples of programs which place demands on the Ranger's time and energy. Intensified use of natural resources coupled with involvement in programs administered by other agencies now require a variety of skills on a Ranger District that would be next to impossible to find in one man.

D. ORGANIZATIONAL CONCEPTS

The Forest Service has traditionally been a decentrailized organization. The theory is that the authority for decision-making (within prescribed limits) should be placed as close as possible to the performance level in the organization. To accomplish this, four levels of organization have been established, with a line officer in charge of each level. They are: the Chief, the Regional Forester, the Forest Supervisor, and the District Ranger. Each line officer reports to the line officer at the next higher level and is responsible only to him. Delegations of authority to each organizational level are spelled out so that each line official knows the limits within which he may take action without referral to higher authority. Numerous studies made of and by the Forest Service throughout the years have so far supported this organizational design.

The organizational study of the Forest Service conducted in 1959 by the consulting firm of McKinsey and Co., Inc., together with a team of Forest Service representatives found no reason to alter the existing organizational concepts. 1/ They did, however, point out many areas needing clarification or sharper definition to meet steadily increasing demands on the lands administered by the Forest Service.

E. THE SIZE OF RANGER DISTRICT STUDY

1. Present Policy and Need for Change

As used in connection with Ranger Districts, the word "size" denotes much more than land area. The number of acres assigned to one Ranger is important from the standpoint of his being able to become familiar with it in a reasonable length of time, but it does not measure the amount or complexity of his work. Therefore, "size" in reference to Ranger Districts is defined as a combination of acres and such other indicators as budget, workload, staffing, resource production volumes, levels of use, and the complexity involved in multiple use sustained-yield management of the natural resources.

Recognition of the increasing intensity and complexity of the Ranger's job brought about a study and resultant policy in size in 1957. The policy was based on the assumption that certain work on the District must be done personally by the Ranger. This was termed non-delegable work and was assumed to be an acceptable indictor of size. Factors were developed that, when applied to the computed base workload for each function (timber, range, recreation, etc.), gave an estimate of the non-delegable workload in these various activities. Similarly, factors were developed for project managerial work. As used in the Forest Service, the term "base work" refers to those jobs that recur year after year and are performed by the Ranger and his staff. "Project work" refers to non-recurrent work which may exist on a District for one or more years and then ceases; as for example, construction of roads and trails. When the total non-delegable work equaled 1,500 hours as determined by applying the workload factors to both base and project work, the District was considered as having a full workload for the Ranger. Anything less was not a full load, and the District was considered too small. More than 1,500 hours of non-delegable work was considered a basis for reducing the District size.

The 1,500 hour guideline does not provide a range of acceptable size. Nor does it help determine the amount of each type of work the Ranger should do personally. This work can and does vary--depending on the ability and experience of the Ranger and his staff. The amount that can be delegated varies by Districts, and even within a District from year to year as the Ranger and staff are changed. Separate factors could be developed for nearly every District and these could and probably should vary with changes in the management situation and personnel on the District. Some administrators apply the guidelines closely; others do not. This difference results in wide variation in applying the policy throughout the Service.

1/ Gearing the organization to the job ahead. McKinsey & Co., Inc., January 1960.

Weaknesses in the 1957 policy on size of Ranger Districts have been recognized. The Chief of the Forest Service, therefore, scheduled a review of the policy in FY 1966. Before the study began, a management review of the Forest Service was made by a team composed of representatives of the Bureau of the Budget, Civil Service Commission, and the Department of Agriculture. Among the recommendations made by this group, two referred to Ranger District size. Action on these two recommendations was deferred pending a detailed study.

2. Participation

Responsibility for the study on size of Ranger Districts was assigned to the Division of Administrative Management, Chief's Office. The study was conducted for the Division of Administrative Management by:

Frank Bell, Management Sciences Staff (PSW)
Walter Graves, Chief, Operations, R-3 (Chairman)
Malcolm Kirby, Management Sciences Staff (PSW)
Ken Norman, Chief, Branch of W. S. & M. U., R-5
Lorraine Presley, Management Sciences Staff (PSW) (Secretary)
Gideon Schwarzbart, Management Sciences Staff (PSW)
Ernst Valfer, Chief, Management Sciences Staff (PSW)

A steering committee was appointed to advise and guide the study group. The steering committee was chaired by Gordon D. Fox, Associate Deputy Chief for Administration, Chief's Office, and consisted of Charles Connaughton, Regional Forester, R-5; Floyd Iverson, Regional Forester, R-4; John Franson, Supervisor, National Forests in Mississippi; Ward Gano, Regional Engineer, R-6; and Chester Shields (ex-officio member), Director, Division of Administrative Management, Chief's office.

3. Objectives of the study were:

(1) To determine whether a relationship exists between size of Ranger Districts and District effectiveness.

(2) To develop criteria to determine the acceptable range in size of Ranger Districts for carrying out Forest Service program objectives effectively and economically.

(3) To establish procedures for evaluating each District or combination of Districts for desirability of size change.

4. Limitations of the Study

The conclusions of this study must be interpreted in the light of the limitations placed on, or assumed in, the study design.

The existing Forest Service organizational hierarchy and definition of the District Ranger's responsibility were to be left unaltered. This

condition led to general acceptance of existing operating and organizational characteristics. District effectiveness was therefore evaluated on the basis of present operations and their relationship to District size. No experimental changes were made in the field nor was any attempt made to evaluate in depth what managerial styles or operating procedures would be most effective for various sized Districts. However, information gathered during field visits did provide some insight into organizational and operational characteristics of Districts of different sizes.

Because the study was confined to the existing population of Ranger Districts, the findings cannot be accurately extended to Districts operating under drastically altered operating conditions and procedures. Therefore, when we state that certains results were observed for a District of a specified size, it does not necessarily mean that other Districts if increased or decreased to this same size would yield the same results.

The restricted concept of Ranger District effectiveness used in this study was based on the subjective evaluation by the Forest Supervisor and his staff of the degree to which Forest Service program objectives, including services to the public, were attained by the District. We assumed that this subjective evaluation bears a sufficient relationship to actual attainment for the purposes of this study. The relative cost of providing these services was considered one measure of effectiveness.

A comprehensive measure of organizational effectiveness would have required an evaluation of the degree to which the organization satisfies the needs of all parties, internal and external, with which it interacts. This concept would have required additional extensive measurement among employees on the Ranger Districts and the various public sectors, and thus would have greatly exceeded the scope of this study. Subsequent studies could treat the congruence of Forest Service objectives, as interpreted at the Supervisor's Office, with the needs of the public, and of the District staff, and of the employees.

II. SUMMARY OF FINDINGS

A. FACTORS CONTRIBUTING TO DISTRICT EFFECTIVENESS

The dominant factor in determining effectiveness is the competence of the Ranger and his staff. This conclusion was verified by replies to questionnaires and by trips to 34 Ranger Districts.

Ranger competence was evaluated separately by technical and managerial performance and District staff competence by technical performance only. When considered both together and separately, competence of Ranger and staff were strong factors contributing to District effectiveness. This conclusion is supported by a University of Southern California study which found that strength in the technical task orientation of District Rangers was more important than personnel management strengths in influencing District effectiveness.

The effect of tenure was brought out only in the field interviews. Most people stated that minimum Ranger tenure should be 3 or 4 years, optimum about 5, and maximum 8 to 10. For District professional staff personnel, the minimum desirable tenure was most often thought to be 2 years, the optimum 3, and the maximum 4 years.

The number of employees on a Ranger District in grades GS-7 and above (including the Ranger) is related to the effectiveness of the District. Evidence suggests that generally Districts with four or more employees in grades GS-7 and above tend to be more effective than those with fewer than four in that grade. Field study findings also indicate the importance of delineating boundaries of a Ranger District so as to encompass enough of any given function to occupy the major portion of a staffman's time.

Other factors contributing to an effective District were proper use of staff, diversified workload (which usually coexists with a large staff), and a good transportation system. No relationships were observed between District effectiveness and such District characteristics as topography, land ownership pattern, and length of field season, nor with any measure of intensity of District management (such as budget, miles of road, or number of visitors per unit of land area).

Delegations of authority to District Rangers have remained relatively constant over the years. These delegations generally are "across the board" with little or no adjustment made because of the volume of work in an activity or the skills available on the District. One exception is the delegation of authority for selling timber.

Utilization of management skills and manpower is bounded by the responsibility and authority vested in the District Ranger. Rangers with high skill levels should have more authority to manage their Districts most effectively.

B. SIZE-EFFECTIVENESS RELATIONSHIP

1. Effectiveness Measured by Subjective Ratings and Rankings.

A preliminary evaluation of information available in the Chief's Office, and a thorough analysis of data collected through questionnaires, revealed only mild yet consistent indications that as a general rule, the larger Ranger Districts tended to be more effective than the smaller ones. This finding arose partly because on larger Districts the Ranger is provided with a staff that possess the professional skills needed to manage the complex resources that exist. From 232 individuals interviewed in field visits, there was a strong consensus that as a minimum each Ranger should have a primary staff of three people. An optimum was considered to be four, and a maximum five. This range is supported by a moderate degree of association between the number of employees GS-7 and above, and measures of District effectiveness.

All size-effectiveness relationships detected in the analysis of the questionnaire data are small in magnitude, and of borderline statistical significance. However, these relationships were always in the direction consistent with a positive size-effectiveness relationship.

Information was not available to determine the type of work Rangers did in the field on various size Districts. Many of the people interviewed believed strongly that Rangers on small Districts spent more time on production tasks and the technical aspects of the work, whereas on large Districts, much more of the Ranger's time was spent on the managerial tasks, such as planning, coordinating, inspecting, and general supervision. This belief is not supported by the questionnaire data, which showed that the Rangers on effective Districts, regardless of size, spend an almost equal percentage of their time on production tasks. Only for the less effective Districts does the percent of Ranger's time on production tasks decrease as District size increases. From field interviews, observation, and judgement, we suggest that Rangers should not spend more than ten percent of their time on production tasks.

The amount of time Rangers spend in the field is independent of District size. Questionnaire responses as well as information collected during field trips indicate that Rangers on large Districts spend about the same amount of time in the field as Rangers do on small Districts. On 20 Districts sampled in the field, Rangers spent an average of 30 percent of their time in the field. This amount varied from a low of 18 percent to a high of 45 percent. The amount of field time appeared to be much more related to the managerial style of the Ranger than to the size of the unit.

2. Effectiveness Measured by Cost of Operations.

a. Present Cost Data

The analysis of operating costs in existing Districts showed that:

(1) There exist "Economies of Scale," i.e., operating costs (Ranger and principal staff salaries, travel and overhead costs) increase slower than District size. The operating costs per unit of District size are, therefore, smallest for the larger existing Districts. These "Economies of Scale" are most pronounced for Districts smaller than size 10, and for the more effective Districts.

The size measure developed for this study was:

$$\text{Size} = \frac{2\ (\text{budget \$})}{10^5} + \frac{\frac{1}{2}\ (\text{Base workload hrs.})}{10^3} + \frac{\text{Acres}}{10^5}$$

(2) Total miles traveled annually by Ranger and staff is independent of both District acreage and travel time to most distant work areas.

(3) As District budgets increase, miles traveled by Ranger and staff also increase (but not as fast as the budget increases).

(4) The number of field trips made by the District Ranger and his travel mileage is independent of District size and of the percentage of his time spent on production tasks.

(5) Above size 7, travel costs for the more effective Districts are uniformly less than for less effective Districts of the same size.

(6) Since other operating costs do not change with changes in effectiveness, total operating costs are less for more effective Districts above size 7.

b. Simulated Cost Data

(1) District Combination

Increase or decrease in District employees' travel time was found to be the most sensitive factor in determining the extent of savings or added costs that will

result from the consolidation of Districts. The location of District headquarters in relation to the combined District and the location of major work areas determine the change in travel time that will result from District consolidation. Thus, not all combinations of even very small Districts will yield annual savings, nor will combinations resulting in large Districts always yield added costs. However, the greatest probability of realizing savings occurs when Districts having headquarters in the same community are combined.

As a general rule, the smaller the size of the combined pairs, the greater the probability of realizing annual savings. If the combined size is 9 or smaller, there is a better than 50 percent probability that savings will occur. If the combined size is 17 or larger, the probability of savings drops to 25 percent or less.

(2) District Splits

Travel time of District employees must be greatly reduced if a split in a District is to result in annual savings.

As a general rule, the larger the size of the District to be split, the greater the probability that annual savings can be realized. If the size is 14 or smaller, there is less than a 25 percent probability of savings, while a size of 23 or larger has a better than 50 percent probability of yielding savings. From the sample studied for splitting, less than 2 percent of the Districts showed savings above $2000.

(3) Optimum Size Range

The optimum size range in size of Ranger Districts was determined to be from a size factor of 9 to a size factor of 22. At size 9 and above, decreases in operating costs per unit of size tend to become minimal. Also, above size 9, the probability of realizing savings through consolidation falls below 50 percent. And a District of this size will, with few exceptions, warrant

at least four employees in grades GS-7 and above. Beyond size 22, the probability of realizing savings by splitting is 50 percent or better. Districts larger than this size may also tend to foster overspecialization, organizational complexity, and remoteness from the land possibly rendering the Ranger unable to devote enough time to major resource management problems.

Although about 75 percent of the existing Districts are below size 9, probably less than one-third of these can be effectively consolidated owing to geographic location, lack of suitable headquarters communities, an adverse effect on service to the public, or an increase in costs.

No Districts now exceed size 22. But if the past 10-year growth is projected, some 10 or 15 Districts may increase beyond this size within the next 10-year period.

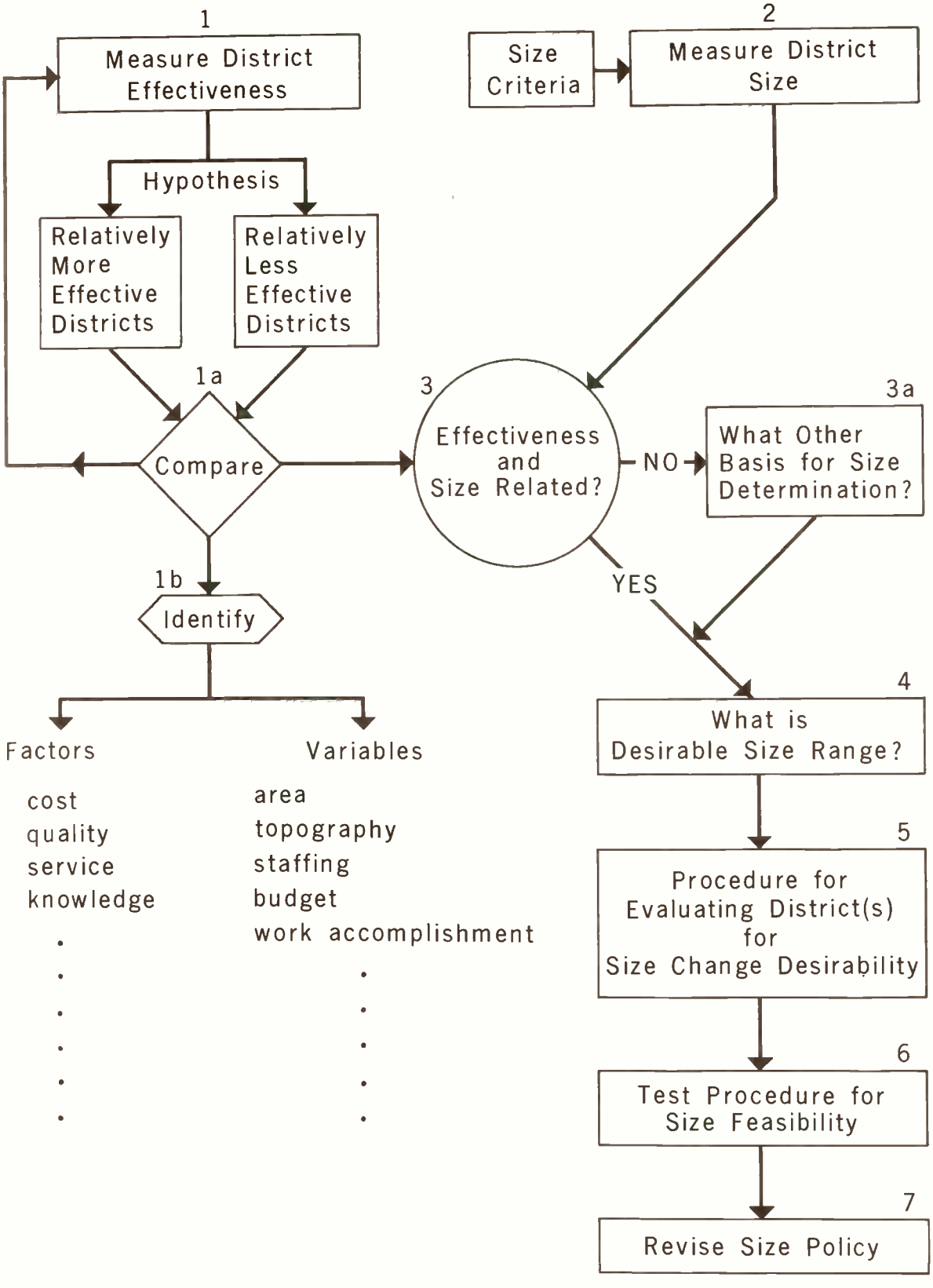
C. SIZE OF EXISTING DISTRICTS AND FUTURE TRENDS

It is evident that over the years Forest Service administrators have been successful in determining the proper size of a Ranger District to meet the particular situations that existed for that unit. This conclusion was verified through visits to 34 Ranger Districts where conditions were checked first-hand, and by an analysis of data from roughly 50 percent of all Districts. Districts have often been adjusted in size to meet changing conditions. And although the net result has been relatively little change in total number of Districts, most of them have been adjusted in size at one time or another. There are still opportunities for further adjustments in size of Ranger Districts, and this study indicates that in general, the larger Districts tend to be more effective, provide better career opportunities, and operate at reduced costs per unit of size.

There is no information to suggest that any existing Ranger District now is too large to be managed effectively. The field study team visited some of the largest as well as some of the smallest Districts. It found that there were both effective and ineffective Districts in each extreme; in no case did it indicate that excessive size was primarily responsible for a low effectiveness rating. This finding does not mean that there is no upper limit on size of Districts, but merely suggests that within the present population, none was found that was considered to be too large to be managed effectively.

As time passes, many Districts will increase in size with little change in acreage. This increase will occur principally through increases in budget and in workload. During the past 10 years, budgets have about doubled and base workloads have increased about 50 percent. If these trends continue, a District of 200,000 acres, with a budget of $100,000 and a base workload of 4,000 hours, could increase from a size factor of 6 to 9 in the next decade.

Figure 1 - Objectives and Schematic Procedure



III. RECOMMENDATIONS

A. ON SIZE OF DISTRICT

1. Consolidate, to the extent feasible, Districts that have headquarters in the same community.

2. Adjust Districts, to the extent feasible, to fall within the optimum size range (size factor of 9 to 22).

3. Adjust Districts where feasible, to accommodate a staff of at least four employees, including the Ranger, in grades GS-7 and above.

4. Take full advantage of opportunities to arrange boundaries which provide enough workload in the major resource functions to warrant the assignment of a staff man to each such function when adjusting District size.

5. Document and evaluate fully the effect the change in size of District will have on:

   a. Public service

   b. Resource management

   c. Organizational management, and

   d. Costs now and 10 years hence.

      (1) If proposed change in size is beneficial, make the change

      (2) If proposed change in size shows few, if any benefits, make no change

      (3) If proposed change in size shows both benefits and adverse effects, make change in size if benefits outweigh adverse effect

6. Reevaluate Ranger Districts periodically to assure that under changing programs and technology, the desirable levels of service to the public and the development of a mature professional organization are maintained at the lowest possible operating cost.

B. ON DISTRICT PERSONNEL MANAGEMENT

1. Adjust delegations of authority to District Rangers to correspond to variations in volume of business and complexity in each function on different size Districts.

2. Continue efforts to assure that the greatest possible number of Districts reach high effectiveness. Because more effective Districts operate at a less relative cost than less effective Districts of corresponding size, a change in size alone is not the entire solution. Careful selection of personnel and improved training programs can do much to help reach this goal. Training programs aimed at improving managerial skills, in particular, can do much to overcome some of the weaknesses that became apparent during this study.

3. Provide that the Ranger and his staff remain on a District long enough to achieve progress in solution of problems and in improvement in resource management. The optimum tenure for Rangers is 4 to 6 years; for the staff, the optimum tenure is 3 to 4 years.

C. GENERAL

1. Study a sample of District size adjustments in detail to determine:

   a. The dynamic effect of actual size change on organization, effectiveness, and costs.

   b. Ways of making a more independent evaluation of effectiveness than was possible in this study.

2. Revise the existing policy in the Manual to reflect the above recommendations.

IV. APPLICATION OF RESULTS

A. GENERAL CONSIDERATIONS

No simple method exists for determining when size of Ranger Districts should be adjusted or the degree to which a change should be made. Each situation must be carefully analyzed in the light of the conditions existing and expected in the future. Priorities can be established for studying needed adjustments, however, and the methods of analysis can be prescribed to insure that all significant factors are fully considered in each study.

Future developments and projections of budgets and workloads should be considered carefully so as to avoid adjustments of Districts today that in a few years may no longer be advantageous. (Detailed instructions for making these projections and also cost analyses were developed during this study and should be assembled in a handbook.)

Any proposals to adjust District sizes must carefully consider the effect of such action on:

1. Service to the public
2. Quality of resource management
3. Operating costs
4. Organizational management

A discussion of each of these points of consideration follows.

B. SERVICE TO THE PUBLIC

As used here, the term "service to the public" means (1) two-way communication in responding to public needs and in increasing public understanding of Forest Service aims, and (2) the importance of sound resource management to insure the continued availability of natural resources. Service to the public also means being readily available

to furnish information about the National Forests to anyone who is interested in camping, fishing, hunting, or just enjoying the scenery; to the individual who depends on the National Forest for all or part of his livelihood; and to the special interest group that is deeply concerned about the condition and use of one particular resource. Districts should not be so large that the Ranger cannot provide these services that the public needs and demands. Neither should the Districts be so small that professional skills cannot be provided to inform and assist the public in the use of the National Forests and to demonstrate the benefits that can be derived from proper management of the resources.

An important part of service to the public is the site of the Ranger District headquarters in relation to the public to be served. If two Districts were consolidated, for example, the elimination of one headquarters might place an undue burden on that District's "public" in trying to reach the Ranger on business. On the other hand, a savings might well result from a consolidation. Such information should be taken into account in any decision to adjust Ranger District sizes.

The term "service to the public" can be extended to include the need for the Ranger to be available to other USDA agencies. Many rural area development programs of the Department of Agriculture involve District Rangers directly or indirectly. And many of the people with whom Rangers must deal also have business with other USDA agencies. To be headquartered in the same community and preferably in the same building with these other agencies provides a "one-stop" service to this clientele as well as encouraging closer coordination of programs involving several agencies of the Department. Proximity of the Ranger's headquarters to heads of local government and associations that play a role in shaping conservation policy is also important.

Besides locating Ranger District headquarters to best serve the public, the needs of employees should be considered in selecting headquarters locations. From the standpoint of morale and of social and cultural advantages, District headquarters should be located in towns with suitable community facilities.

Obviously, it is not always possible to adjust the size of Ranger Districts and to locate the headquarters so as to meet all of the needs expressed above. Nevertheless, all of these needs must be considered by the administrator before deciding to change District size or headquarters locations.

C. QUALITY OF RESOURCE MANAGEMENT

Resource management includes the development, use, and protection of all of the resources on a Ranger District. The results that may be

expected must be carefully analyzed before the size of a District is altered. A change in size can result in greatly improved resource management by providing needed professional skills. But it may result in so overloading the Ranger that he has little or no opportunity to become personally acquainted with the problem areas on the District, and is not able to take corrective action. On the other hand, reducing the size of some Districts may result in the loss of professional help to the point where the Ranger must handle most activities himself; and, as a result, has less time to concentrate on major problems.

D. COSTS

The major items determining changes in costs as a result of altering the size of Ranger Districts are: (a) salaries due to changes in number and grades of employees; (b) travel due to changes in headquarters location; and (c) rents and utilities at headquarters. Other costs include the impact on the Forest Supervisor's office owing to increasing or decreasing the number of Districts, but unless several Districts are added or deleted, the changes in these costs are relatively minor.

In some situations, consolidation or splitting of Districts may result in a sizeable savings in annual costs. Yet when service to the public and the effects on resource management are considered, no change should be made.

It is difficult to assign universal priorities or weights to (a) service to the public; (b) resource management; or (c) costs because in any given situation any one or two of these factors may be controlling. Weighing is a management function custom-tailored to each situation.

E. ORGANIZATIONAL MANAGEMENT

In the final decision process, organization management becomes crucial only at and beyond the upper boundary of the optimum size range. Conceivably, a District could become so large and complex that the Ranger could not become familiar enough with his land and employees, and would be forced to spend so much time just managing his organization that he could not devote enough time to resource management problems. The staff should not become so specialized that it loses the perspective of total resource management.

F. PRIORITIES

To help select the most logical Districts for adjustment in size, we suggest the following set of priorities. Changes in size may sometimes involve complete Districts (e.g., the combination of two Districts

into one, or the split of one into two); yet some of the best possibilities may be to make two Districts out of three, or three out of two. Still other adjustments in size may not change the number of Districts at all, but merely redistribute management responsibility by shifting a District boundary. Adjustments in District sizes should be made a few at a time--as analysis and approval is completed and public acceptance is gained.

In each priority category, start with those Districts which offer the most favorable opportunity for adjustment.

First Priority: Consider consolidation of Districts with headquarters in the same community. This change will usually reduce total operating costs and will often improve public service. The key factors will be the effect on resource management and organization complexity.

Second Priority: Consider increasing the size of Districts with a size factor of less than 9.

Third Priority: Consider increasing the size of Districts with fewer than four permanent full-time employees in grades GS-7 and above, including the Ranger, regardless of size factor.

Fourth Priority: Consider reducing the size of any Districts with a size factor above 22. (Do not project workload and budget before calculating the size factor.)

Fifth Priority: Consider adjusting the sizes of all other Districts where to do so would increase the total benefits obtained from service to the public, quality of resource management, and operating costs.

V. METHODOLOGY

A. STUDY DESIGN

1. Study Hypotheses and Overview

The Study Plan implicitly stated the hypotheses:

a. Among the existing 822 Ranger Districts can be found some which can be judged by the Forest Supervisors and their staff to be managed effectively (near-optimal) in terms of accomplishment of Forest Service program objectives.

b. The factors and variables contributing to operating effectiveness can be isolated and identified.

c. Size of Ranger District and operating effectiveness are not independent.

The study proceeded through three distinct stages after acceptance of the Study Plan. The first stage represented a survey of the entire District population (N = 822) with respect to the overall effectiveness of each District and of the factors potentially contributing to effectiveness. The second stage represented a size-cost-effectiveness relationship exploration based on detailed information regarding these factors for a sample of the population of the Districts, and on the results of field trips. The third and final stage (not described in the Study Plan) concerned the examination of changes in costs resulting from simulated combinations and splits of Districts based partly on actual field data (see Figure 1).

2. Population Description

The study population comprised the 822 administrative units, called Districts, of the entire National Forest and National Grassland System. These Districts do not form a homogeneous population, and the following factors were assumed to influence materially the cost-size-effectiveness relationships:

a. Topography (two classes):
   Predominantly rough
   Predominantly smooth

b. Landownership pattern (three classes):
   Compact landownership not heavily interspersed by private holdings,
   Mixed landownership of State or private and National Forest land, and
   Isolated parcels of National Forest land completely separated by lands of other ownerships.

c. Length of season (two classes):

Long working season (eight months or more)
Short working season (less than eight months)

d. Dominant District function (four classes):

Predominantly timber
Predominantly range
Predominantly recreation
Mixed (two or three of the above functions about equal in importance)

The population was stratified by primary District functions. The primary District function was based on the measured relative management workload hours called "Base Workload" for each function in combination with production or use levels. These "base" production and use levels reflect current activity on each District. They do not necessarily give a balanced picture of the resource development needs of each District. These measurements are relative and Districts classified by similar primary District functions may vary greatly in size and importance of their programs.

Soil, water and wildlife management are extremely important resource activities, requiring an increasing amount of attention from District management in the future. They are not strongly reflected in the "base" and were therefore not used in this stratification. Furthermore, they are relatively constant among all Districts and therefore, do no lend themselves for population stratification. But this should not be interpreted to mean that they are of lesser importance in determining the management needs of an administrative unit.

Topography, landownership, and season were used as classification categories in subsequent analyses. The size of the sample was partially determined by the heterogeneity of the population.

3. Overall Population Survey - First Questionnaire

A preliminary questionnaire requested information about the overall effectiveness of each District in each National Forest. Each District was separately rated for overall effectiveness by the Forest Supervisor and each of his primary staff. A scale from one to ten was used with ten being the maximum effectiveness evaluated in accordance with the general objectives of National Forest Administration. In addition, each Forest Supervisor was asked to explain in narrative form the significant reasons for the rating assigned to the highest and lowest Districts. The primary purpose of this questionnaire was to use the information as the basis for selection of a sample of Districts for detailed review and analysis which would permit most readily the identification and isolation of the factors and variables yielding highest and lowest levels of operating effectiveness and quality of management

a. High-low effectiveness groups.

The information from the first questionnaire was used to identify the group of 221 Districts of highest and lowest effectiveness for special review and study. Assigned to this group were all Districts

with an average rating of eight and above as most effective, and four and below as least effective. This group contained 119 high effectiveness level Districts, and 102 low effectiveness level Districts. Districts with average effectiveness ratings (5-7), were not included in this sample group. The information obtained from the sample questionnaires was augmented by information on budget, workload, and other operations data from the Washington Office files, and formed the basis for a preliminary assessment of the size-effectiveness relationships.

4. Selection of Effectiveness and Cost Study Sample

This sample was composed of the 221 high and low effectiveness level Districts from the first questionnaire augmented by an additional stratified (by function) random sample of 204 Districts from the remaining 591 Districts, after eliminating the ten Districts in Region 10 (Alaska). The Districts in R-10 were eliminated because their large acreages and relatively light workloads do not fit the situations existing in other Regions. Because of the relative scarcity of recreation function Districts, this stratum was sampled at one hundred percent. The other three functions were sampled so that each stratum in the total sample would be in proportion to its representation in the total population.

Table 1 shows the composition, by function, of the final 418 District sample. The final sample is not equal to the initial sample (high-low effectiveness levels), plus supplemental sample. Of the 425 selected sample Districts, 421 questionnaires were returned. Four Districts did not return questionnaires because of organizational changes. Of the 421 returned questionnaires, three had to be eliminated because of incomplete data leaving a total of 418 Districts. A final review of functional classification resulted in increasing the mixed function category, and reducing the single function categories.

Table 1. -- Composition of final sample by main functions.

Functions	Total Sample Breakdown by Functions	
Timber		81
Range		121
Recreation		36
Mixed (Total)		180
All 3 functions	(62)	
Timber-Range	(26)	
Timber-Recreation	(78)	
Range-Recreation	(14)	
	Total	418

The large sample (comprising over 50 percent of the population) was necessary because of:

a. The need to evaluate the high-low effectiveness group in comparison with random sample.

b. The need for a sizeable group of Forests contributing more than one District to the sample (rank correlation study).

c. The heterogeneity of the population.

d. The administrative convenience of collecting one large sample rather than repeated small samples.

5. Second Questionnaire

A second, more detailed, questionnaire elicited information about the selected sample of 425 Districts. This information was again requested from the Forest Supervisor's office for the Districts located within its jurisdiction. Whenever responsibility for a given function was clearly assigned to an individual staffman in the Supervisor's office, the pertinent information was requested from him only. This, it was hoped, would yield the most authoritative opinion which was of special importance when subjective evaluation was requested. Subjective evaluations of activities not clearly assigned to the jurisdiction of any individual were requested independently from all staffmen, the Forest Supervisor, and the Deputy Forest Supervisor.

This questionnaire represented an effort to secure detailed and comprehensive information about a District's effectiveness, together with related items such as personnel characteristics and managerial style. Operating costs and budget information were also included.

For purposes of evaluating effectiveness, three specific areas of a District's operations were recognized:

a. Resource management.

b. Relationships to the general public.

c. Internal employee relationships.

A number of questions relating to each area were included in the questionnaire for evaluation by means of interval (rates), ordinal (ranks), and ratio (percentages, proportions) scale measurement. This wide variety of measures was necessary because no single measure was fully satisfactory. (See discussion about measures.) The effectiveness measures were as follows:

Resource management

Subjective measures (rates and ranks):
Timber, range, wildlife, and watershed management, fire control, recreation, and land uses.

Task accomplishment (in percent):
Survival of planted trees, timber cut and sold, range allotment analysis and inspection, land use inspections (by frequency class).

District operating costs - These included rental and utilities costs, Ranger, principal staff and clerical salaries, and travel costs.

Relationship to general public (rates and ranks):
Public relations, appeals and complaints, and trespass prevention effectiveness.

Internal employee relationships
Morale (rates and ranks)
Accident frequency rates: Personal and vehicular safety on District and Forest.

The remaining categories of information in the questionnaire concerned:

Evaluation of District personnel - Rates and ranks for technical competence of the Ranger, technical competence of the Staff, and managerial competence of the Ranger.

District organizational characteristics - Personnel compositions and rates, tenure, percent of time spent on various manual work tasks by Ranger, and by principal staff.

District Budget - Total District budget for FY 1966. Included all funds allotted to District except those held in Supervisor's or Regional office for contracts, and work done by crews from the Supervisor's office.

The main questionnaire was accompanied by a questionnaire supplement to be filled in by the Administrative Officer at the Supervisor's office requesting descriptive (demographic) information about the District not easily available from a central source. This included information on tenure, number of professional personnel and their Civil Service classification grade, total number of non-professional employees, number of primary staff, longest travel time to major work areas on the District.

Definite guidelines, including items to be considered in evaluating each question, accompanied the questionnaire. If other considerations were important in reaching a decision, it was requested that they be listed. The cost of accomplishing certain functions was specifically noted as constituting a factor in arriving at an overall evaluation of accomplishment when appropriate.

6. Changes in Costs Resulting from District Combinations or Splits.

a. Purpose

In order to shed some light on the dynamics of salary, travel, and facilities costs associated with size changes due to combining a pair of Districts, or splitting Districts, a simulation study was made. This study was begun after results from the questionnaire analyses indicated that such an approach would be desirable. The objectives of the simulation study were to estimate the change in operating costs which can be expected from District combinations, and from District splitting, and to relate these to District size. The study differed from the usual simulation study by not utilizing theoretical District models, but actual sample Districts. The term "simulation" here means that combinations, or splits, were considered with little regard to their practicability, and that theoretical assumptions were made regarding paths of travel and location of headquarters.

Combining two Districts into one may not generally represent the most favorable situation. Greater economies may result from combining three into two, or four into three Districts. A similar situation exists in splitting a District into two. It may be more economical to split a District among two or more other Districts. These multiple considerations were not studied because of the complexities of choice associated with such multiple rearrangements and the limitations of time.

b. Simulation sample.

The simulation sample for District combinations was drawn from the population of feasible District pairs prepared at each Regional Headquarters. All pairs of Districts were considered feasible if they had a common boundary or were not separated by National Forest land administered by a third District. Districts separated by severe topographic obstacles were excluded. Crossing National Forest boundaries was not permitted. The total number of feasible pairs amounted to 737. Ten sample pairs of Districts were selected randomly from each Region (except R-10), representing, on the basis of a rough count, an eleven percent sample of all pairs. The sample size was determined by the minimum requirements of this study, and the feasibility of obtaining and analyzing the amount of information involved.

A total of 147 Districts comprised the sample, yielding 80 District pairs because some Districts appeared in more than one combination. Because of the failure to follow instructions, one pair had to be eliminated, leaving a sample of 79 District pairs. Only 67 of these 79 District pairs were used for cost evaluation because 12 District pairs resulted from duplicate use of Districts. The 147 Districts were not necessarily part of the size-effectiveness sample.

The sample for District splits was obtained by sub-sampling the sample for District combination. Districts of sizes two and three were eliminated; the remaining Districts were divided into two equal groups according to size. A random sample of 17 Districts was then chosen from the group of smaller Districts and 34 from the group of larger Districts. In order to obtain a sample of larger Districts (and also to gain better insight into potential biases present in the District combination) seven Districts were chosen randomly from the smaller half of the previously combined Districts and 14 from the larger half. This resulted in a total of 72 Districts studied for splits.

The previous questionnaire did not provide all the necessary information for the simulation study. A separate questionnaire was therefore designed to collect simulation data.

c. Population of potential pairs.

Table 2 shows the total number of potential pairs of Districts in each Region. The last column lists the number of potential pairs when each District is used not more than once.

Table 2 -- Population of potential pairs

Region	No. of Forests †	Total No. of potential pairs	No. of potential pairs without duplication
1	16	85	42
2	15	93	37
3	13	70	35
4	18	146	50
5	17	80	35
6	16	54	34
8	14	100	41
9	15	109	36
Totals	124	737	310

d. Characteristics of sample Districts.

Figures and tables in Sec. VI, p. 81, give pertinent information on the 147 Districts used in this simulation. They list many of the diverse characteristics of existing Ranger Districts and serve as a basis for comparison with the proposed District combinations to be described later.

† Proclaimed National Forests under a single Forest Supervisor counted as one unit.

7. Field Interviews

a. Purpose.

The objectives of these interviews were to:

(1) Verify proper interpretation of the questions on the second questionnaire.

(2) Validate study assumptions and questionnaire design to assure that significant variables had not been left out.

(3) Gather data by interview that would be difficult or impossible to obtain by questionnaire, or that had been unintentionally omitted.

(4) Gain a current knowledge and understanding of management situations facing Rangers in representative areas of the National Forest System.

b. Field study sample selection.

The field study sample constituted a non-random selection from among the high and low effectiveness Districts designed to include as many as possible from each of the following categories:

(1) Geographic distribution. Include Districts in each Forest Service Region (except Alaska).

(2) Functional distribution. Include Districts in each of the four primary functional categories (timber, range, recreation and mixed).

(3) Size of Ranger Districts. Include large, medium, and small Districts.

(4) Variation in topography, season of work, and landownership pattern.

A total of 34 Districts were visited. The purposes of the field visits did not require that the field sample contain all existing combinations of variables b. (1) - (4). Questionnaire data could serve this need. In addition, the time and cost of travel limited the number of visits.

A logical and efficient travel route was plotted which permitted visiting a representative cross-section of Districts so that the most significant levels of variables b. (1) - (4)were represented.

The selected travel route followed roughly an elliptical path counter clock-wise through the Nation, in order of Regions 5, 4, 3, 2, 8, 9, 1, 6. The visits to six Districts in Region 5 served as a prototype and test for perfecting the check list and interview procedure.

c. Data collection.

Two men, traveling together, made all the field visits. They had 33 and 16 years experience in the Forest Service. Their combined experience ranged over all levels in the Forest Service organization -- Ranger District, National Forest, Regional, and Washington Headquarters.

Each Forest and District visited was notified in advance of the planned date of the visit, but was given no detailed information on items to be covered. The team first visited the headquarters of each Forest where one or more of the 34 sample Ranger Districts were located, and then the selected District(s). Each question of the previously completed questionnaire for the relevant sample District was reviewed with that person (Forest Supervisor or primary staff) who had supplied the answer. After reviewing the questionnaire responses, these individuals were interviewed further in two general areas:

(1) To gain an impression of the managerial style and delegation of authority and responsibility on the Forest as it affected the Ranger Districts.

(2) To solicit opinions about factors that might be significant in establishing a Ranger District size policy.

A check list was used for conducting the interviews.

For the above interviews, the team split up; each member talking to one person at a time. Generally, one day was spent at the Forest headquarters. A similar procedure was followed at the Ranger District. The District Ranger and his primary staff were interviewed. The verification of questionnaire replies was not repeated. In its place, an analysis of Ranger field trips was made from data available on the District.

The interviews were of a semi-structured nature. All the questions in the check list were pursued, but not necessarily in the exact words. Deviation from check list topics was encouraged if the interviewer felt that to do so would shed light on the topic.

B. MEASURES

1. Composite Size Measure

This measure was designed to express the over-all managerial complexity of a Ranger District using objective criteria applicable to all Regions and all Districts. The reliability of this measure was not tested beyond its ability to categorize Districts by size into five size classes defined below; and its usefulness does not necessarily extend to situations where a different concept of use is required. The size measure was evaluated by comparing it with independent subjective size class ratings for 34 Districts from Regions 3, 4, 5, and 8 familiar to the study staff. The results of this test were:

Finding	Number of Districts
Complete agreement	16
Underestimate by one class	9
Overestimate by one class	7
Difference larger than one class	2
Total	34

Because of the uncertainties of subjective classification, agreement between the two measures was judged as adequate if such agreement was within one class. On this basis, our size measure provides a serviceable size criterion. The size formula used three components: budget, base workload, and acreage.

$$\text{Size} = (2\ \text{budget}/10^5 + 1/2\ \text{base}/10^3 + \text{acres}/10^5).$$

The first component, budget, is used as an over-all measure of activity which is the major determinant of managerial complexity. The second component, base workload, measures the time-constant element of activities and thus acts as a stabilizer. Acreage gives weight to the impact of physical size as a possible limiting factor. (See figure 1A.) The role of the divisors 10^5 and 10^3 is to give a comparable weight to the three components of size, and to reduce the size measure to the scale of units. The factor 2, which multiplies budget, is designed to offset the low modal value of the frequency distribution of budgets (see figure 2), and the factor 1/2, associated with base time, corrects for the overlap between budget and base since both measure recurrent activities (see figure 3). In general, weights were used sparingly because of their inherent arbitrariness. Their only purpose is to provide the desired balance among the three components, and provide a rough adjustment for the effects noted.

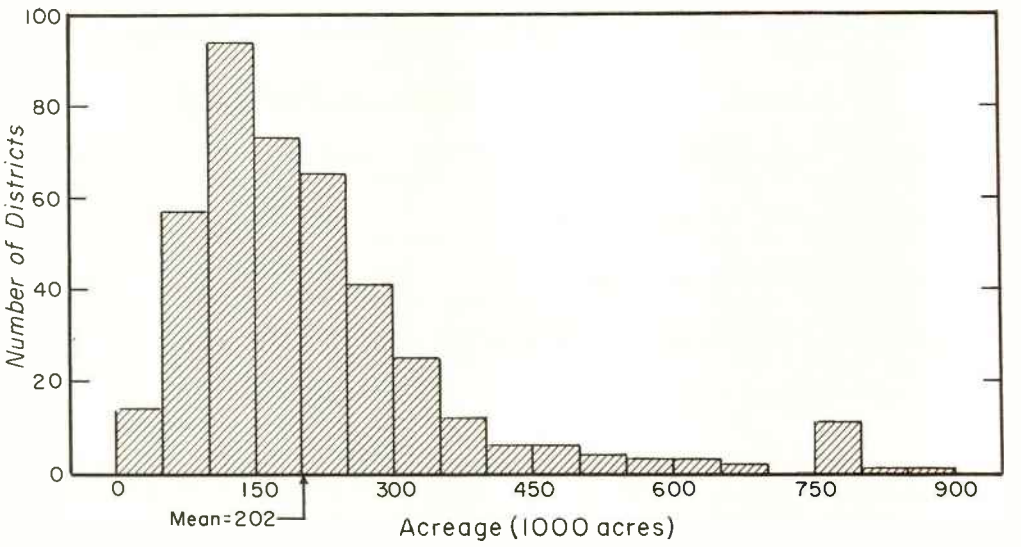


Figure 1A. Frequency Histogram: Acreage of 418 sample Districts.

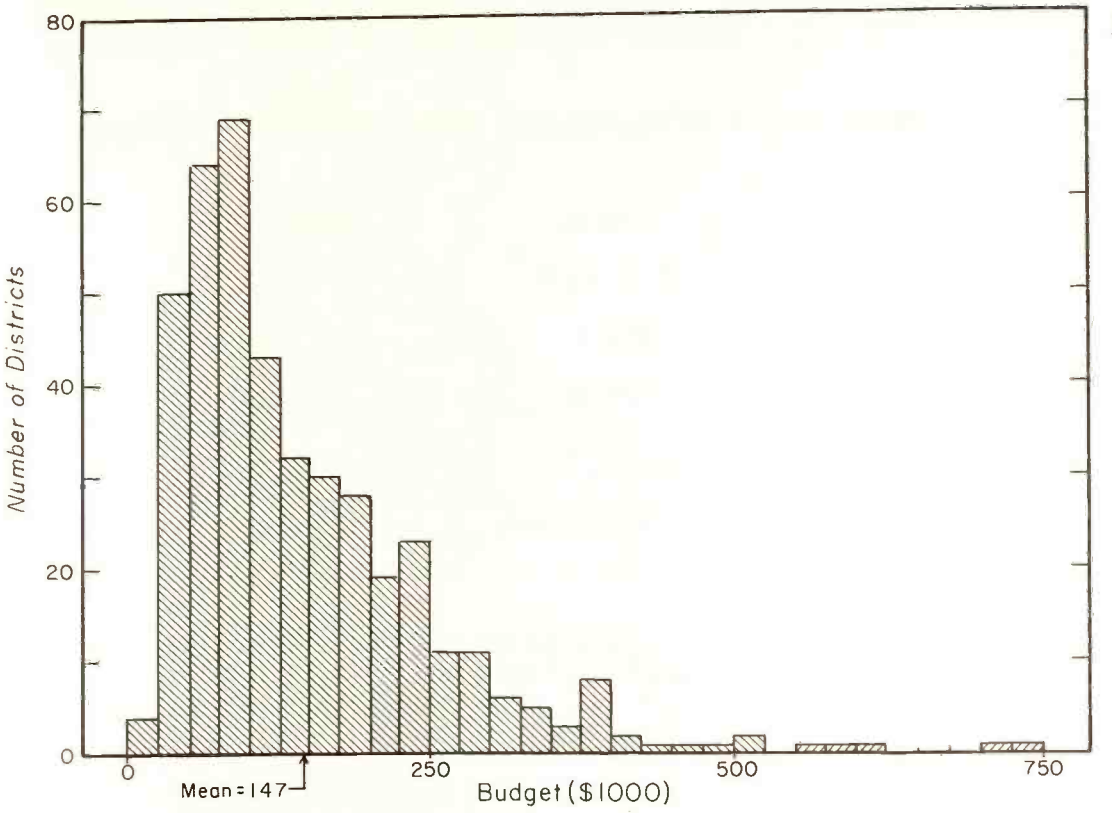


Figure 2. Frequency Histogram: Budget of 418 sample Districts.

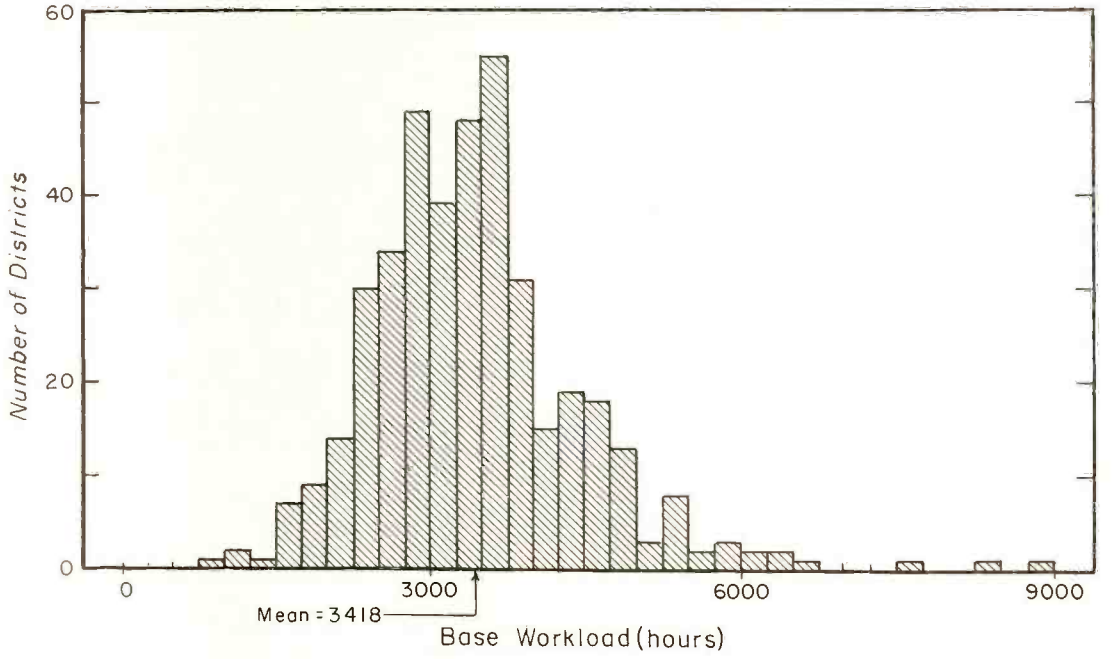


Figure 3. Frequency Histogram: Base workload of 418 sample Districts.

With the above size formula, the five size classes were defined to be:

Size Class	Size	No. Districts
5 (smallest)	4 or less	76
4	5 and 6	164
3	7 and 8	86
2	9 and 10	56
1 (largest)	11 and above	36
Total		418

Histograms of the size distribution of the sample Districts are shown in figure 4 and subdivided by primary function in figure 5. The range function exhibits the narrowest size range because of absence of large Districts.

Figure 6 shows the divergence of size patterns between Regions. Only Regions 5 and 6 possess an appreciable percentage of Districts in size classes 2 and 1 (sizes 9 and larger). In all other Regions, size classes 5 and 4 (sizes 0 - 6) are dominant.

The discussion of the composite size measure developed here would be incomplete without a mention of other suitable size determining components considered for, but not used in, the size formula presented here. Foremost among these were quantity and composition of staffing. These components were not included in the size measure presented here because of Regional differences in staff structure, and utilization of professional and non-professional personnel, and the consequent lack of comparability. Staff size is naturally a component of budget and a function of base workload. Project managerial workload was also considered to be a suitable component for a comprehensive size measure. This component was not included because questionnaire respondents did not interpret uniformly this questionnaire item, and because it was felt to have been weighed sufficiently as a element of the budget.

As a check, and in order to gain better insight into the size relationships, the individual components of the size measure, especially acreage and budget, were also used separately as size indicators in a number of analyses.

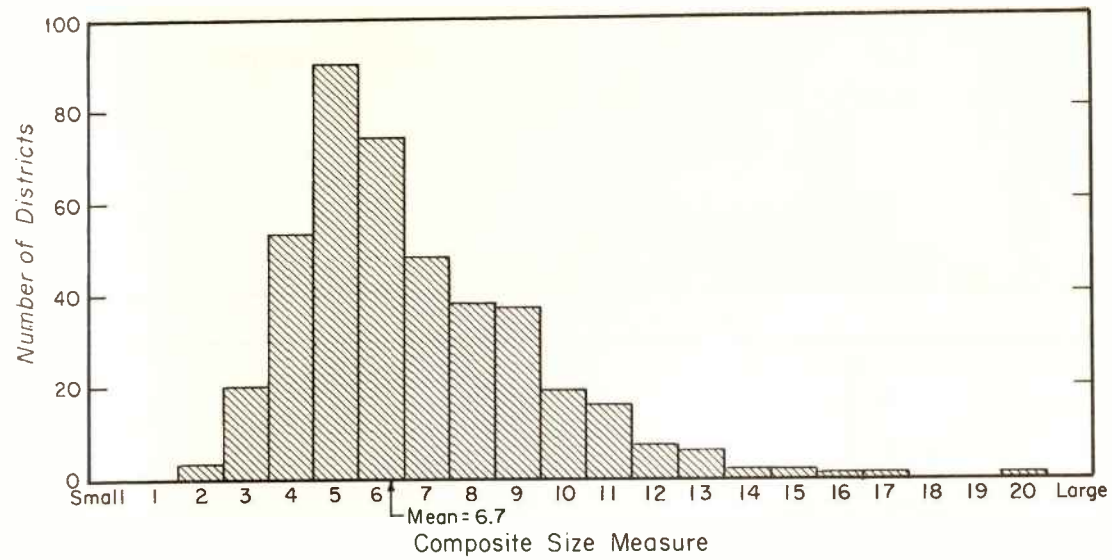


Figure 4a. Frequency Histogram: Size of 418 Sample Districts.

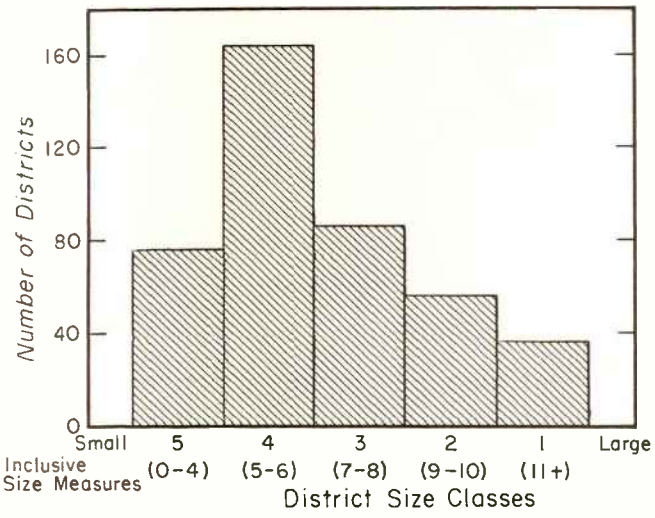


Figure 4b. Frequency Histogram: Size classes of 418 sample Districts.

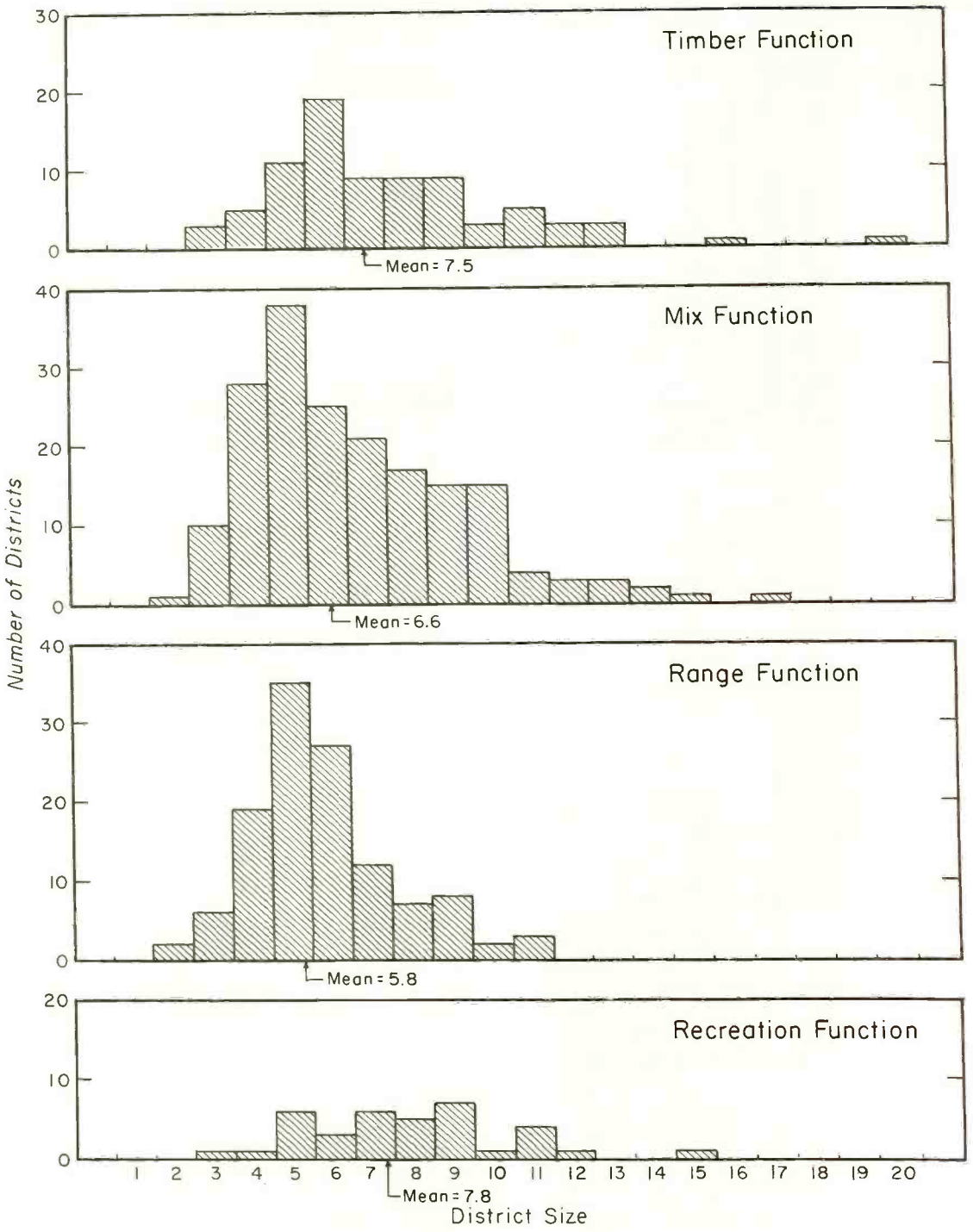


Figure 5. Frequency Histograms: Size of 418 sample Districts by primary function.

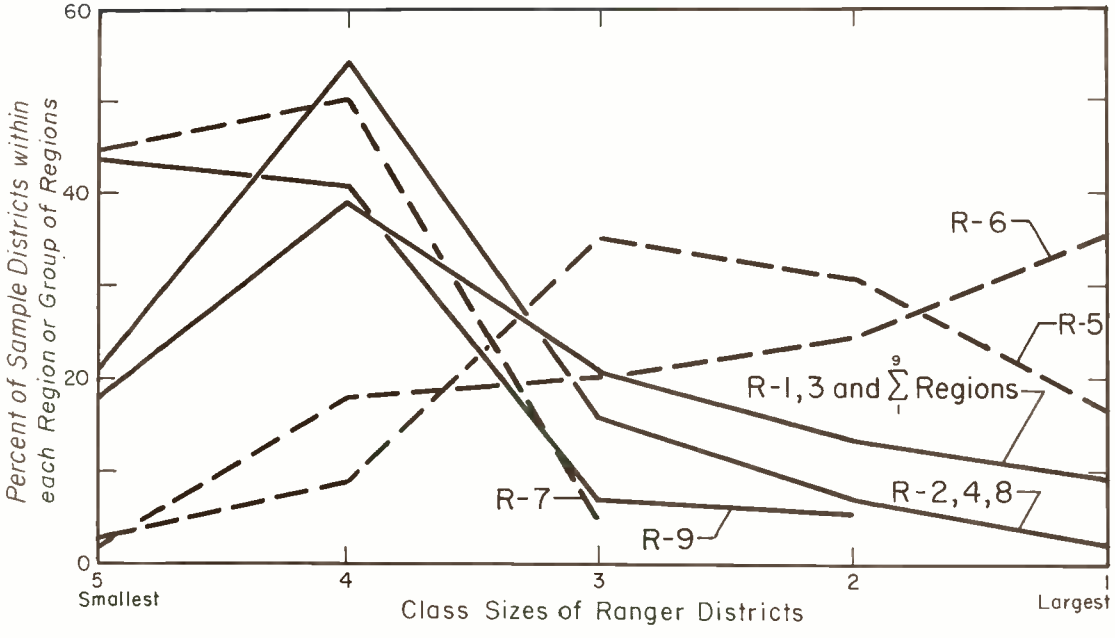


Figure 6. Percentage distribution of sample Districts by size classes and Regions.

2. Measures of Management Intensity

These measures represent a somewhat different concept of managerial complexity based on the potential or demand for development, and for work. Three such measures were used: total District budget dollars per acre of District, miles of available road per 1000 acres of District, and annual number of recreation visitors per 1000 acres. This concept was inforporated into the study because intensity of management may be presumed to be associated with managerial style and, thus, may clarify effectiveness relationships obscured by the other size measure.

3. Effectiveness Measures

a. Objective Measures

In the second questionnaire, actual operating cost data on salaries, travel, overhead and rental costs were requested.

When building occupancy costs were not available, estimates based on square footage and commercial rental rates were substituted. Travel costs were computed on the basis of average salary rates, average rate of travel, total mileages or frequency, and average mileage of trips plus per diem costs, where applicable, and equipment rental charges. These costs, thus, have validity only as an over-all District travel cost measure. Cost measures associated with the simulation part of the study incorporated specific assumptions made on headquarters location, travel distribution, and staffing requirements. Other objective effectiveness measures attempted to assess task accomplishment, and such operating characteristics as Rangers' and staffs' time utilization and safety records.

b. Subjective Measures

(1) General

The effectiveness measures were of three types: effectiveness ratings, effectiveness rankings, and percentage accomplishment data.

Ratings were assigned values on a scale of 1 (most effective) to 5 (least effective). Such evaluations are generally difficult to make and may prove unreliable. Therefore, another evaluation was requested in the form of a ranking without ties of all the sampled Districts within a forest based on their standing for the evaluated items, relative to all other Districts on the Forest. Ties were intentionally proscribed to make this measure free of the tendency to avoid extremes. Not allowing ties carries a penalty which constitutes a weakness of our ranking measures, the possible exaggeration of minute differences between two subsequent rankings.

Two types of ratings and rankings were used in this study. Those based on the evaluation by a single staffman at the Forest level assigned with responsibility for a specific function, and those based on the evaluation of all respondents (Supervisor and primary staff) at the Supervisor's office when the questionnaire item could not be tied to a single individual at the Supervisor's office. For the latter, a single rate or rank was obtained by averaging the individual rates or ranks and rounding to the nearest integer. The arithmetic average was chosen in preference to other measures such as the median, because it was judged desirable to place the single value for ranks and rates showing wide divergence, thus identifying an insecure judgment, into the neutral, middle category e.g. it was thought preferable to evaluate the ratings 1 2 1 5 5 as 3 rather than the median value 2. Since our main interest was in the extreme ranges, only those Districts rated or ranked uniformly high or low influenced these.

(2) District functional effectiveness.

The District functional effectiveness ratings and rankings were based on the total accomplishment within some fairly broad, well defined area of endeavor, deemed a natural task unit (timber, range, fire, etc.). An attempt was made to have the sum of these tasks encompass the whole of a District's activities. In assigning a rate, the rater, or raters, were requested to evaluate the District's effectiveness in the light of goals and standards set for each geographical area. In this way it was hoped to secure a valid measure independent of the geographic confines of the District.

(3) Primary function effectiveness.

In order to gain "across the board" comparability for the primary function of a District, a new rating and ranking scale was devised from the questionnaire data. The ranks and rates for this category correspond to those the District received for the appropriate function or, in the case of mixed functions, to the arithmetic average of the rates and ranks given the functions which make up the mixed classification for the District.

If, for example, three Districts were ranked for timber and range as follows:

District No.	Primary Function	Ranking for Functions		
		Timber	Range	Primary
1	Timber	4	4	4
2	Range	3	1	1
3	Mixed (timber-range)	2	3	3 (2.5 rounded)

The primary function effectiveness is then shown in the last column. District No. 2 is therefore the most effective of the three in managing its main function.

This procedure has validity if, as was assumed, all primary functions are of equal concern to us. Such an assumption might, however, not always be justified. For the distribution of the sample Districts according to primary function effectiveness see figure 7.

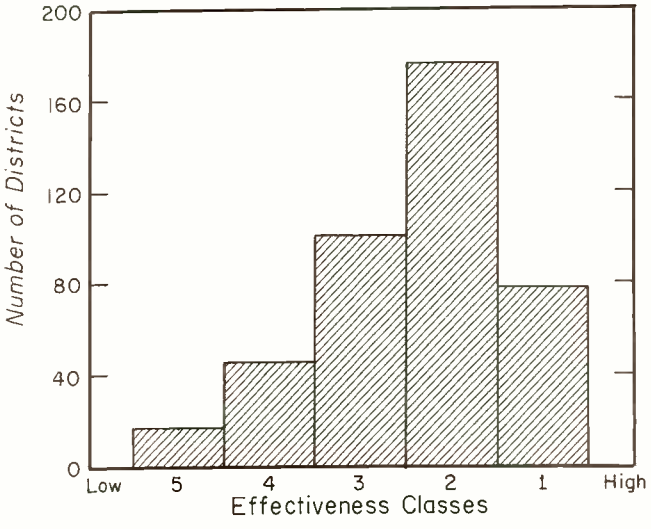


Figure 7. Primary function effectiveness rating (418 sample Districts.

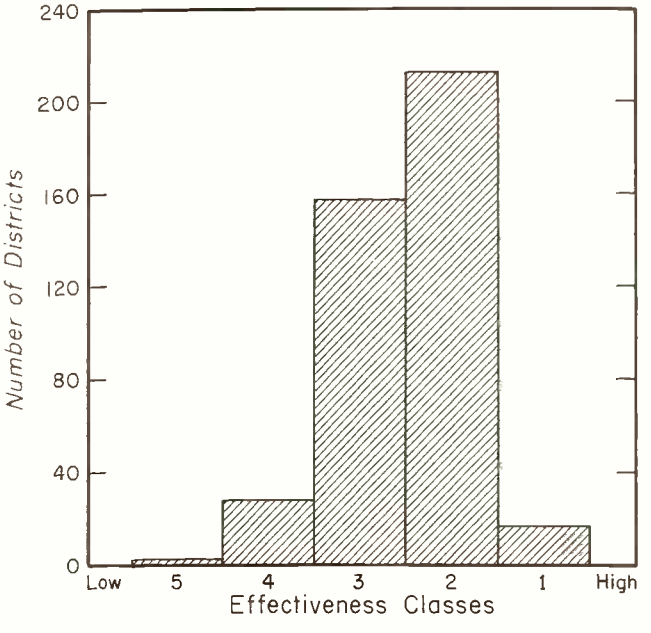


Figure 8. Composite effectiveness rating (418 District sample).

(4) Composite effectiveness measures.

Several effectiveness measures were grouped together to form the composite measures. Their rates and ranks were derived from those of the separate measures.

An over-all effectiveness measure was constructed based on primary function effectiveness, external relations effectiveness, and internal relations effectiveness. (figure 8) The last was measured by morale. External relations effectiveness comprised three categories (trespass, appeals and complaints, public relations). These three categories were averaged before becoming a component of the more inclusive measure within which each of the three main components, i.e. primary function, external relations, and internal relations effectiveness, carried an equal weight of one third. Similarly, in all other composite measures each main component carried an equal weight. In all cases, averages of averages were taken before the individual averages were rounded off in order not to compound the rounding-off errors.

(5) Personnel Competence Measures

Personnel competence was evaluated for both the Ranger and his staff by means of rates and ranks independently assigned by all Supervisor's office personnel concerned with the questionnaire. The Ranger was ranked and rated for competence in two categories of skills, i.e. technical skills and managerial skills; whereas, the staff was evaluated only for technical competence. A single rate and rank measure for each category and subject (District staff or Ranger) was obtained by averaging the rates and ranks assigned by the Supervisor and his staff, and rounding to the nearest whole number. A composite measure of the professional competence of the Ranger including both technical and managerial skills was obtained by averaging the two averages. The composite measure of the professional competence of Ranger and staff was obtained by averaging all three averages (technical and managerial competence of Ranger, plus technical competence of staff).

4. Organizational Characteristics

The questionnaire and supplement contained several items indicative of organizational characteristics, such as personnel composition and GS grades, number of principal staff, Ranger and staff tenure, and the non-supervisory participation in production work by Ranger and staff. The last item might be considered a clue to the managerial style of the Ranger. The remaining items are subject to strong administrative constraints and Regional biases.

The Ranger's manual work participation was measured by the percentage of total time he spent doing the following tasks: marking timber, scaling logs or measuring other convertible products, counting livestock or wildlife, maintaining structural improvements of all types, and inspecting special uses. Also counted was one-half of the time spent on making range allotment analyses or game range analyses. For staff manual work accomplishment, the above list was supplemented by two additional items: direct supervision of project crews, and collecting recreation sticker fees.

C. METHODS OF ANALYSIS

1. General Considerations

Special care in both analysis and interpretation of results was necessary because the District population is finite and the sample size relatively large (over 50 percent of population). Furthermore, one part of the sample, the high-low effectiveness group constitutes a non-random selection from the population. This required a careful consideration of the sample distribution characteristics and of the precision of the estimators.

The analytical methods used were determined by the nature of the particular size, cost, or effectiveness variables, and the underlying measurement scale as well as the nature of the sample and the hypothesis being tested. Four methods of initial formal analysis were employed: goodness of fit, multi-way contingency tables, rank correlations, and regression analysis.

Beyond the purely formal analyses, trends and interrelationships were noted and used to lend additional weight to our conclusions.

2. Size-Effectiveness Analysis - Subjective Measures

In order to evaluate the stated hypothesis (III A.1) of non-independence of size and effectiveness, the various measures describing dimensions of District operating effectiveness, internal and external relations were tested in single and composite form against the size measure. The test procedures and statistics depended on the characteristic of the data and the statistical requirements for each test.

a. Goodness of fit test.

These tests were used when the random and non-random (high-low effectiveness group) components of the sample were compared with each other to see whether there existed significant differences between them in terms of responses to specific items or dimensions in the questionnaire.

b. Multi-way contingency tables.

This form of analysis was employed for exploring relationships involving rates and/or classification categories (e.g. topography, District function, staff size, etc.). The exploration of multiple relationships was possible by this method if only two or three levels were used for each variable.

The number of effectiveness levels was reduced for many analyses to three:

Level	Questionnaire Response Rates
High	1 and 2
Intermediate	3
Low	4 and 5

When necessary, a two-point scale was used, with the intermediate category assigned to the low effectiveness group.

Because of the sufficiently large sample sizes, significance tests were based on the chi-square approximation to the exact distribution. The degree of association in contingency tables was expressed by means of the Kendall τ_c (11) or, in the case of square tables

and when no difficulty of cross comparisons was involved, the Kendall τ_b(11) rank correlation coefficient. Both coefficients have under these circumstances an approximate range between -1 and +1 and generally both provide only slightly different numerical values for a given table.

c. Rank correlation methods.

The degree of correlation between pairs of attributes (e.g. size-effectiveness) when these were evaluated by ranks, was estimated by using the Kendall τ_b statistic. These statistics measure the consistency (i.e. how often the same trend occurs between pairs of ranks) rather than the strength of trends. The τ_b coefficient incorporates a correction for tied ranks. This type of analysis was dictated by:

(1) The ranking scheme provided for ranking of all Districts on a Forest. On the average, only half of a Forest's Districts were part of our sample. The rankings of the sample Districts were, therefore, incomplete and retained only a relative, rather than an absolute, standing among each other.

(2) Some ratio-scaled measures (e.g. size, tenure, etc.) were interpreted as ranks (highest, next highest, etc.) for purposes of this analysis. They became, therefore, only indicative of relative standing, and could not be interpreted in any absolute sense.

A correlation coefficient was computed separately for each Forest as required by our method of ranking Districts. Only a moderate number of Districts from each Forest was generally part of our sample; the actual range was from two to eleven Districts per Forest.

A sufficient number of Forests with six or fewer sample Districts were generally available for significance tests based on the average rank correlation for a given frequency class. Tests were usually performed only for the two groups of four and five sample Districts per Forest which represented the best compromise between number of sample Districts available per Forest, and the number of Forests giving optimum test conditions. Significance tests were based on the assumption of normality derived from the tendency of the distribution of (i) the means, and (ii)the rank correlation coefficients for uncorrelated samples of ten or more items to approximate normality. For a single average correlation coefficient this lead

to the customary "student t" test. For a vector of average correlation coefficients associated with various aspects of a given relationship, (such as the relationship of effectiveness measured along various functional categories to size), the multivariate normal Hotelling T^2 test was used.

A finite population correction based on the over-all sample and population sizes, and assumed to hold approximately for the sub-samples based on sample Districts per Forest categories, was applied to the variance estimates in the univariate case.

Correlations for the fixed high-low effectiveness group were interpreted as fixed parameters.

3. Size-Effectiveness Analysis - Objective Measures (Cost)

a. Regression Analysis.

Trends in cost relationships (present and simulated) such as size-cost relationships, were analyzed by means of linear or quadratic regression models. The relevant data points were plotted; their distribution suggested the particular model used. The degree of over-all fit was assessed by means of the usual F-ratio test, and the coefficient of determination, under the assumption of the regression model specifications (independent normally distributed variables with equal variances). The contributions of single regression coefficients were evaluated by the "student t" test.

4. Simulation Methods

a. Combinations.

The simulation data generation process was dependent on the following model specifications:

(1) Selection of combined District headquarters location at:

(a) Either of the two existing headquarters locations.

(b) An entirely new location.

(2) The choice of the headquarters location depended on:

(a) Balance and distribution of workload and volumes between the two Districts.

(b) Road network.

(c) Availability of community facilities.

Not considered were such variables as the cost of abandoning a relatively new headquarters representing a sizeable investment and socio-political variables. These realistic considerations were assumed to become part of any specific field evaluation, and would then influence the manager's decision.

(3) Travel and salary rates - assumptions.

(a) The workload on any District is uniformly distributed over the entire District area.

(b) The trips made on each of the original Districts are necessary. The number of trips will remain constant. Travel responsibility may be shifted to other staff members. Travel time and mileages will vary, and are dependent on District headquarters location.

(c) Visits by District staff to the Supervisor's office, and by Supervisor's office staff to the District, will be reduced because of consolidation. The mileage and consequent travel time depends on the distance between the two offices.

(d) The grade of the District Ranger for the consolidated District was determined as follows:

i. If either of the two Rangers was a GS-12, the grade of the Ranger on the consolidated District remained GS-12.

ii. If neither Ranger was a GS-12, the Ranger on the consolidated District was assigned a grade of GS-12 if the size index for the District was 10 or more. If the index was less than 10, the grade of the Ranger remained at GS-11.

The grades of other personnel on the District were determined by a review of workloads and volumes of business. The manning table for each District combination was reviewed and agreed upon by three of the study team members experienced in National Forest Administration.

(e) The third step (GS effective October 10, 1965) of the grade for each position on the District was used in computing total salary costs, and salary costs involved in travel. The third step of GS-12 was used for computing salary costs involved in travel of Supervisor's office personnel to District headquarters.

(4) Staffing level.

Three major factors were considered in determining the staffing (exclusive of clerks) for the combined new District:

(a) Savings in base workload resulting from consolidation.

(b) Reduced or increased "on District" travel time as a result of the consolidated District's headquarters location.

(c) Reduced, or increased travel time by District personnel to the Supervisor's office.

The algebraic sum, of the above changes, to the nearest 0.1 man year was the basis for adding to, leaving unchanged, or reducing staffing on the combined District.

The clerical staffing for each of the two original Districts and the consolidated District was based on the computed base clerical workload to the nearest 0.1 man years. The project clerical workload was assumed to remain constant.

Changes in District size were assumed to have no effect on the staffing level at the Supervisor's office. It is realized that certain savings may occur in the Supervisor's office when a District is eliminated. There will be fewer reports of all kinds to be reviewed, fewer District-wide management plans, fewer inspections, less correspondence to be prepared, and fewer Rangers to counsel. However, some of these reductions may be offset by the necessity for Supervisor's staff to spend more time per trip on the larger and more complex unit resulting from consolidation. Also, the savings in man hours would be divided among so many different individuals that the elimination of one District would not result in a reduction in staffing at the Supervisor's office level.

(5) Space requirements.

(a) Office space.

Existing office space was not used in the calculations since it may be more, or less, than is now needed. One hundred square feet of office space was allowed in all cases, including the combined District, for each yearlong employee in grade GS-5 and above, and for clerks regardless of grade or season of employment. Four hundred square feet of space was added at each office for corridors, rest rooms, and general utility space.

(b) Space for warehouses, garages, and all other.

Existing space was given in the questionnaire for the sample Districts. Space needed for the new District was estimated by taking the larger square footage given on an existing District and adding one-half the amount given for the other District.

(6) Rental rates.

(a) Office rental rates per square foot were given on the questionnaire for each existing District when a rate was known. When not given, a rate of $3.00, an approximate nation-wide average, was assumed.

For the new, combined District, if one of the existing headquarters was used, the rate for that location was used, if known.

(b) Warehouse, garage, and all other rental rates.

The same principle was used as in (6) (a) above except when no rate was given, an assumed rate of $1.00 per square foot, an approximate nation-wide average, was used.

(7) Utilities.

Cost of utilities at each existing District headquarters was listed in the questionnaire. These costs were adjusted for the change in office space calculated under (5) (a) above. Then, to develop a utility cost for the new District, the weighted average utility cost per square foot for the existing Districts was applied to the square footage calculated for the new District.

(8) The differences between assumptions made, and actual conditions, could easily amount to an over, or under, estimate of $2000. For this reason, savings or added costs had to amount to $2000 or more to be considered.

b. Splits.

The model specifications for splits were:

(1) Choice of headquarters location depended upon:

(a) Road network

(b) Availability of community facilities

(2) Travel and salary rates.

(a) The workload on each half of the original District was assumed to be equal and evenly distributed over the entire area.

(b) The total number of trips made on the District was divided equally between the two halves.

(c) Travel from the Supervisor's office was doubled as a result of splitting the District.

(d) If the size of either of the Districts, after splitting, was below 10, the Ranger was assigned the grade GS-11; if the size was 10, or above, the grade was GS-12. The grades of the Ranger's principal staff were based upon the Ranger's grade (i.e. principal staff of a GS-12 Ranger were GS-11, while those of a GS-11 Ranger were GS-9). Other personnel on the Districts retained the same grade as shown for the original District.

(e) The third step (GS effective October 10, 1965) of the grade for each position was used in computing total salary costs and salary costs involved in travel. Supervisor's office travel was based upon the third step of GS-12.

(3) Staffing level.

The staffing level was handled in a similar fashion to that outlined for combinations.

(4) Space requirements.

(a) Office space was handled as before.

(b) Space for warehouses, garages, etc. for each half of the split District was one-half that of the original District. This was an assumption tending to favor the splits.

(5) Rental rates and utilities costs were handled as for combinations.

(6) The same ± $2000 was used for identifying savings or additional costs.

c. Probability of Realizing Savings.

The cost consequences of each simulated District combination or split were plotted against District size. Two linear regressions (one for combinations and one for splits) were calculated with various level confidence bands appropriate for a single new combination or split. A curve of the probabilities of realizing savings due to combinations or splits (figure 28) was plotted from the intersections of the confidence bands for various levels of confidence with selected lower bounds for savings (see figures 25-27). Each of these intersections determined the probability associated with a combined size, or size prior to splitting, and these points were connected by a smooth line to obtain the probabilities for all intermediate sizes. The probability associated with the lower confidence band at the point of intersection is one-half the complementary value (to one) of the confidence coefficient. The probability associated with the upper band is this amount, plus the value of the confidence coefficient.

VI. ANALYSIS OF FINDINGS

A. DISTRICT CHARACTERISTICS RELATED TO EFFECTIVENESS

The first questionnaire solicited opinions from the field concerning District characteristics that might be related to effectiveness. (See METHODOLOGY). Each Forest Supervisor was asked to explain in narrative form the significant reasons for the rating assigned to the highest and lowest rated District on his Forest. There was no limitation placed on the number or type of reasons to be given in each case, and the reasons needed not to be ranked according to their relative importance. The listed reasons were tabulated separately for the most and least effective Districts as rated on this same questionnaire. Those reasons appearing only once or twice in all responses were not considered to be sufficiently universal to be listed below.

CHARACTERISTICS OF MOST EFFECTIVE DISTRICTS ON EACH FOREST

Item Number	Characteristic	Frequency of Listing
1.	Balanced diversified workload	75
2.	Adequate to large staff	25
3.	Good access routes and transportation system	55
4.	Centrally located hdqtrs. and work centers	49
5.a	Compact land area	23
5.b	Good ownership pattern	18
6.	Well-qualified Ranger and staff	23
7.	Adequate administrative improvements	7
8.	Good communications system	10
9.	Long field season	13
10.	Cooperative public and users	8
11.	District mostly in one county	4

CHARACTERISTICS OF LEAST EFFECTIVE DISTRICTS ON EACH FOREST

Item Number	Characteristic	Frequency of Listing
1.	Poorly balanced workload	35
2.	Low staffing	29
3.	Poor access	41
4.	Headquarters not located near work	18
5.	Checkerboard, scattered land pattern	33
6.	Weak personnel	16
7.	Inadequate headquarters facilities	10
8.	Poor communications system	8
9.	Strongly seasonal workload	12
10.	Light workload	12
11.	District too small	11
12.	District too large	3
13.	Undeveloped resources	9
14.	Separate summer-winter headquarters	5
15.	Too many interior communities	7
16.	Improperly measured workload	5

The tabulations of characteristics in each case above are arranged in such a way that the first nine items in each list are contrasting, or express positive and negative views of the same characteristic. Items 10 and 11 for most effective Districts, and items 10 through 16 for least effective Districts have no counterpart in the other list.

Some of the characteristics listed have a relationship to district size. Most of them, however, describe inherent characteristics that cannot be readily affected by manipulating district boundaries.

The above tabulated characteristics, and a large number of volume of business items, were checked against the District ratings in the first questionnaire to determine if there were some obvious size-effectiveness relationships. No conclusive evidence of such relationships was found. However, this rough screening did have value in pointing toward areas that appeared to warrant further exploration in later questionnaires and in the field visits.

B. EFFECTIVENESS RELATIONSHIPS

1. Subjective Measures

a. General Summary

The study of the relationships of District effectiveness to selected District characteristics yielded several important results with regard to existing National Forest Districts.

i. The correlation of District effectiveness to the competence of the District personnel (Ranger and primary staff) is highly significant, positive, of a high order of magnitude and present for all effectiveness criteria used.

ii. The correlation between District effectiveness and District size (as previously defined) was statistically non-significant and of a low order of magnitude. However, the analysis yielded indications of a consistent, residual relationship, positive when District Ranger competence was high, negative when District Ranger competence was low. No relationship was observed between the selected intensity of management indicators and district effectiveness.

iii. The most and least effective Districts (as identified by the preliminary survey) show a moderate degree of association between the number of professional employees GS-7 and u and District effectiveness evaluated by the overall composite and main function effectiveness measures.

iv. No significant change in the stated conclusions is associated with topography, land ownership pattern, and length of field season.

Our findings are limited by the nature of the study which was based on a sample survey, and not on experimentation. Each observed District has presumably adjusted, over time, to compensate for the special difficulties imposed by local conditions. This may explain the absence of otherwise expected relationships.

b. Size-District Effectiveness Relationships

The relationships in this category are generally borderline relationships both as to their statistical significance and their degree.

The centrality of these relationships to the present study necessitate, however, a detailed discussion.

(1) Size-District Over-all Effectiveness

A weak, positive size effectiveness relationship (the " τ_c " contingency coefficient equals .36) is apparent for the non-random sample component using the preliminary over-all District effectiveness measure. No such relationship exists, however, for the random sample component evaluated by the same preliminary effectiveness measure. The composite effectiveness measure shows no size-effectiveness relationship for either the non-random or random sample component. This result points to the possibility that size considerations, or considerations associated with components of size, entered into the responses to the first questionnaire.

For Districts with low Ranger professional competence ratings (ratings 3, 4 and 5) a very weak, negative (τ_c = -.072) but statistically significant (5 per cent level) relationship exists between size and effectiveness for the composite effectiveness measure. No such relationship between size and effectiveness was detected for other measures of effectiveness. The significance of this finding relates to the actual manifestation of the predictably negative influence of low-competence Rangers.

No significant change in the size-effectiveness relationship was introduced by eliminating differences due to topography, length of field season and land ownership pattern. In general, the random and non-random sample components showed a very similar composition with respect to these variables which further confirmed the lack of importance of these factors.

(2) Size-Functional Effectiveness

Functional effectiveness is a measure based on a single function, and assigned by a single individual and thus, perhaps, is based on more immediate knowledge, and is free of the defects due to averaging. Nevertheless, no statistically significant relationship exists between size and functional effectiveness. Average rank correlations for this group generally do not exceed .25, and are generally non-significant on the basis of a " t " test (including a finite sample correction factor of .8). Table 3 shows the rank

Table 3. -- Average rank correlations between size and functional effectiveness for Forests with four and five sample Districts

Function		Four Districts per Forest		Five Districts per Forest	
		Avg. rank correlation	No.# Forests	Avg. rank Correlation	No.# Forests
Primary Function	Wide range of sizes †	.16	(12)	.13	(7)
	Narrow range of sizes ††	.04	(14)	-.002	(11)
Fire Control	†	.09	(11)	.06	(7)
	††	.18	(13)	.22	(11)
Wildlife	†	.25	(12)	.23**	(7)
	††	-.17	(14)	-.09	(11)
Land Management	†	.34*	(10)	.25	(8)
	††	.06	(13)	.05	(11)
Watershed Management	†	.16	(12)	.04	(7)
	††	-.09	(15)	.02	(10)

* Significant at the .05 level.
** Significant at the .01 level.

Of a total of 124 Forests

† Difference between largest and smallest sample Districts for each Forest is four or more size units

†† Difference between largest and smallest sample District for each Forest is less than four size units

correlations for Forests with four and five sample Districts which include approximately one-half of the sampled Districts. The Forests were separated into two groups: those having a range of sample district sizes of four or more size units and the remaining ones. An examination of the table will reveal a consistently higher average rank correlation for the Forests with the wide range of sizes. Even though generally non-significant, this effect lends strength to the hypothesis of the reality of a small (positive) correlation between size and functional effectiveness. A noteworthy exception is that of size versus fire control effectiveness which exhibits an opposite relationship. This would indicate that fire control effectiveness is even less related to size than the other functions, and this conclusion does agree with the relative centralization of the fire control efforts.

Table 4 shows a moderate degree of statistically significant correlation between primary function effectiveness and effectiveness in other functions. The fire control function shows the highest degree of correlation, highly significant, due primarily to the high correlation between fire control effectiveness and professional competence since the latter is also highly correlated with primary functional effectiveness (table 5).

(3) Size-External and Internal Relations Effectiveness

No discernable relationship exists between size and accomplishment of public relations tasks, handling of appeals and complaints, and trespass cases. Table 6 shows the average rank correlations for Forests with four and five Districts, separated on the basis of a wide and narrow range of District sizes. The table also shows the average rank correlations for personnel morale which again shows no relationship to size.

c. Professional Competence-District Effectiveness Relationships

Professional competence, whether that of the Ranger or staff, whether technical or managerial, appears from among all the factors explored, to be most closely associated with District effectiveness. The evaluation of the professional competence of the Ranger does not appear to be related, either positively or negatively, to his length of stay on the District (Ranger tenure). The two components of professional competence of the Ranger (technical and managerial) are strongly correlated (weighted average rank correlation coefficient .77) and thus, no differentiation as to their respective contributions is possible.

Table 5 shows that the correlation between professional competence and various District effectiveness measures is especially strong for morale, trespass, and the fire control function.

Table 4. -- Average rank correlations between primary function and functional effectiveness rankings

Function	Four Districts per Forest		Five Districts per Forest	
	Avg. rank correlation	No. # Forests	Avg. rank correlation	No. # Forests
Fire Control	.39**	(24)	.43**	(18)
Wildlife	.31**	(26)	.21*	(18)
Land Management	.8*	(23)	.23*	(19)
Watershed Management	.22**	(27)	.08	(17)

Of a total of 124 Forests

* Significant at the .05 level
** Significant at the .01 level

Table 5. -- Average rank correlations between professional competence of Ranger and District effectiveness for Forests with four and five sample Districts

Area of Activity	Four Districts per Forest		Five Districts per Forest	
	Avg. rank correlation	No. # Forests	Avg. rank correlation	No. # Forests
Primary Function	.39**	(26)	.53 **	(18)
Fire Control	.43**	(24)	.59**	(18)
Wildlife	.25**	(26)	.28**	(18)
Land Management	.19	(23)	.46**	(19)
Watershed	.29**	(27)	.25**	(17)
Public Relations	.32**	(26)	.43**	(18)
Appeals and Complaints	.14	(24)	.41**	(18)
Trespass	.47**	(25)	.63**	(18)
Morale	.54**	(25)	.64**	(18)
Composite Over-all	.46**	(26)	.71**	(18)
Preliminary over-all (rating)	.46**	(22)	.63**	(17)
Technical competence of primary staff	.63**	(26)	.56**	(18)
Ranger Tenure	.03	(23)	.17	(17)

Of a total of 124 Forests

** Significant at the .01 level

Table 6. -- Average rank correlations between size and external and internal relations effectiveness rankings for Forest with four or five sample Districts

Competence Measures		Four Districts per Forest		Five Districts per Forest	
		Avg. rank correlation	No. # Forests	Avg. rank correlation	No. # Forests
Public Relations	Wide range of sizes †	.08	(12)	.38*	(7)
	Narrow range of sizes ††	.28*	(14)	.08	(11)
Appeals and Complaints	†	-.24	(10)	.29	(7)
	††	-.22*	(14)	-.09	(11)
Trespass	†	-.13	(12)	.23	(7)
	††	.16	(13	-.04	(11)
Morale	†	.14	(12)	.24	(7)
	††	.01	(13)	.18	(11)

* Significant at the .05 level

Of a total of 124 Forests

† Difference between largest and smallest sample District for each Forest is four or more size units

†† Difference between largest and smallest sample District for each Forest is less than four size units

However, the relationship is sufficiently uniform for the question to arise whether the evaluation of the professional competence of the Ranger and staff does, in part, determine the District's effectivness evaluation. This question cannot be fully answered in the present study.

A similar finding of the close correlation of Ranger competence to District effectiveness was made by Pfiffner, et al(4) in their study of Ranger Districts. They found that the most effective Ranger District had a District Ranger who was strong in planning, safety enforcement, pressure for production and discipline, organization, decisiveness, competence, and had good public relations. Strengths in the Ranger's technical task orientation was found by Pfiffner to be more important than his personnel management strengths for achieving an effective District.

An increasing correlation between size and the professional competence of Ranger and staff can be observed for Forests with the wider range of sizes (table 7). The positive relationship of Ranger and staff competence to effectiveness may suggest the cause for the slight residual relationship that appears to exist between size and District effectiveness for all functions.

2. Organization Factors-Effectiveness

A weak (τ_c = .18), but statistically significant (5% level), positive relationship exists between the average staff tenure and the over-all, preliminary District effectiveness evaluation. A similar relationship also exists for the composite (τ_c = .15) and the primary function (τ_c = .16) effectiveness evaluation within the non-random sample component only.

Among the organizational factors of length of Ranger tenure, Ranger participation in manual tasks, number of primary staff and number of professional employees, only the last mentioned has shown any relationship to effectiveness. A positive, high (contingency coefficient τ_c =.63) degree of association exists between the number of professional employees GS-7 and up, and the preliminary over-all effectiveness rating. This association exists, however, only for the non-random sample component. For the random component, no significant (5% level) relationship exists. Similarly, for the non-random sample component, the " τ_c " contingency coefficient is .39 for the composite measure of effectiveness and .30 for the primary functional effectiveness evaluation. For the random component, again, no significant association exists between these variables.

Table 7. -- Average rank correlations between District size and professional competence of Ranger and staff for Forests with four and five sample Districts

Competence Measures		Four Districts per Forest			Five Districts per Forest	
			Ave. rank correlation	No. # Forests	Ave. rank correlation	No. # Forests
Professional competence Ranger	Wide range of sizes	†	.24*	(12)	.35	(7)
	Narrow range of sizes	††	.14	(14)	.10	(11)
Professional competence Ranger and staff		†	.24*	(12)	.43	(7)
		††	.17	(14)	.10	(11)

* Significant at the .05 level

\# Of a total of 124 Forests

† Difference between largest and smallest sample District for each Forest is four or more size units

†† Difference between largest and smallest sample District for each Forest is less than four size units

It can thus be conjectured that the high-low effectiveness Districts are partly characterized by the staffing level of professional employees GS-7 and up, and that this characteristic constituted one of the elements on which the preliminary over-all effectiveness rating is based.

3. Objective Measures of Effectiveness

a. Cost Relations

The second questionnaire contained information on district operating costs. This section discusses the relationship of costs to district size and other selected district variables. A separate test was made for each of the four functions and, where appropriate, for each effectiveness level (low, medium, or high) of the sample districts. Where significant relationships exist, regression equations were calculated and curves plotted -- linear or quadratic. The statistical parameters are described in Section V, C.3. The regressions define only average trends, individual districts may vary from these trends.

The relationships for the recreation function are not as statistically significant as others because of the small sample size of recreation districts. When timber, range, or mixed functions are listed as showing a significant relationship between the examined variables and recreation is not listed, the difference may be due to sample size rather than the nature of the relationship between the variables. Variables were always tested in pairs -- e.g., operating costs vs. size.

Whenever a quadratic (U-shaped) regression curve provided a better fit to the data than a straight line, it was used. There is, however, no assurance that the quadratic curve provided the best possible fit since other potentially applicable curves were not fitted. Sometimes a minimum (lowest point of the U-shaped curve) for some value of the independent variable (usually district size) falls within the existing data range. This apparent minimum generally occurs in the size range of the largest existing districts where very few data points are available. While a minimum might thus be hypothesized to occur within the data range in some instances, the fitted U-shaped curve does not necessarily prove its existence where data are sparse. To reduce the possibility of drawing conclusions from insufficient data, the interpretations of the curves were very conservative.

(1) Salaries Versus District Size

(a) Total Staff Salary vs. District Size

i. Description

The relationship of the combined salaries of the District Ranger, his principal staff and the District Clerk (s) were plotted linearly for the mixed and recreation districts,

and quadratically for the timber and range districts (fig. 9). When a linear and quadratic curve both were significant, the quadratic curve was generally used. The regressions are highly significant at the 0.5% level for all four district types. All regression equations are listed in Appendix D. The regression curves have different lengths because the different district types have varying size ranges. The curve for the range districts is shortest, for example, because there were no range districts in this sample larger than size 9.

All curves have a positive intercept, if the curves were extended to district size zero, staff salary costs would be greater than zero. Due to the positive intercept salaries increase at a slower rate than district size. This indicates economies of scale.

Salary cost/size were plotted vs. size in figure 10. The range and timber districts show linear decrease in cost/size as size increases while the mix and recreation districts show a leveling off at approximately size 12-13. This is consistent with the previous graph. It is possible that in respect to salary cost an optimum district size exists -- this must remain a hypothesis. Within the range of existing district sizes, the available data did not prove the existence of optimality with respect to salary cost.

ii. Conclusions

(i) There appears to be a "fixed" salary cost which is independent of size. It is least for range districts.

(ii) Salary costs are highest, generally, for timber and lowest for range districts.

(iii) As size increases, salary costs increase linearly or at a rate less than linear.

(iv) Salary costs increase at a lesser rate than district size.

(v) Therefore, there exist "economies of scale" for salary costs.

(vi) For recreation and mixed districts, the decreasing salary/size curves flatten out at sizes 12-13.

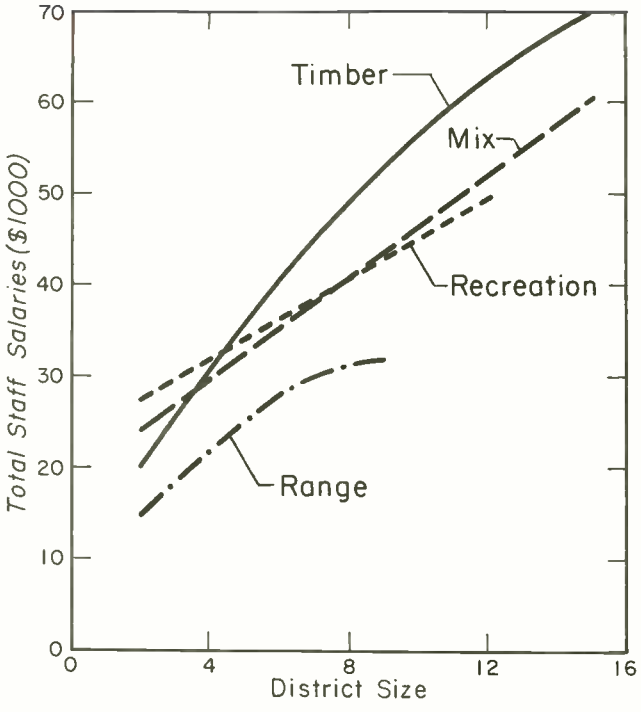


Figure 9. Total staff salaries versus size by primary function.

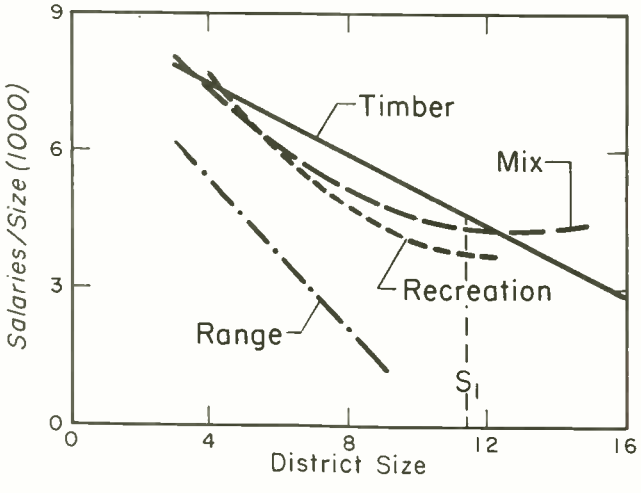


Figure 10. Total staff salaries per size versus size.

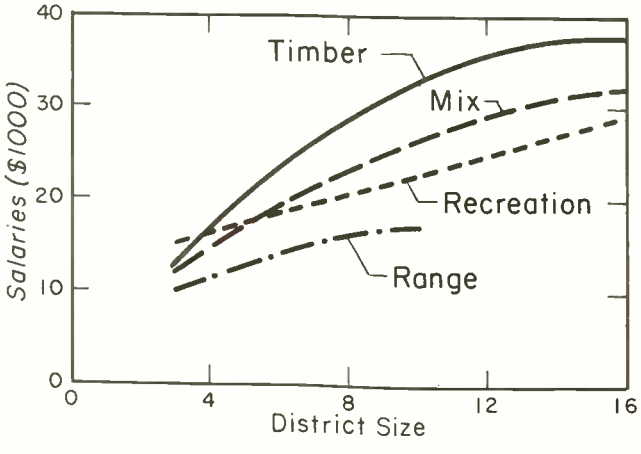


Figure 11. Principal staff salaries versus size.

b. Principal Staff Salaries vs. District Size

i. Description

The relationship of principal staff salaries to size (figure 11) is similar to that of total staff salaries (figure 9) but with lower costs for any given size. Only the recreation districts show a linear increase in salaries with size, the other functions are quadratic showing decreasing rate of increase. Except for the recreation function, there is no appreciable positive intercept at size zero. This is expected since principal staff is more directly related to size than total staff salaries.

ii. Conclusions

(i) Principal staff salaries increase at a lesser rate than district size.

(ii) Apparently principal staff salaries tend to "level off" for the larger districts (above size 12), increasing only slightly with further increases in district size (within the range of existing district sizes).

(iii) "Economies of scale" exist for principal staff salaries.

(iv) Principal staff salaries are highest for timber, lowest for range districts of equivalent district size.

c. Clerical Salaries vs. District Size

(1) Description

There is a highly significant (0.5% level) positive linear relationship (i.e. directly proportional) between clerical salary cost and district size (figure 12). For the timber, recreation, and mixed functions, clerical salaries increase approximately in a ratio of $1000:1 unit district size. For the range function, the ratio of salaries/size is $150:1. (This latter relationship was previously presumed to exist for all functions.) The zero size intercept is above $2000.

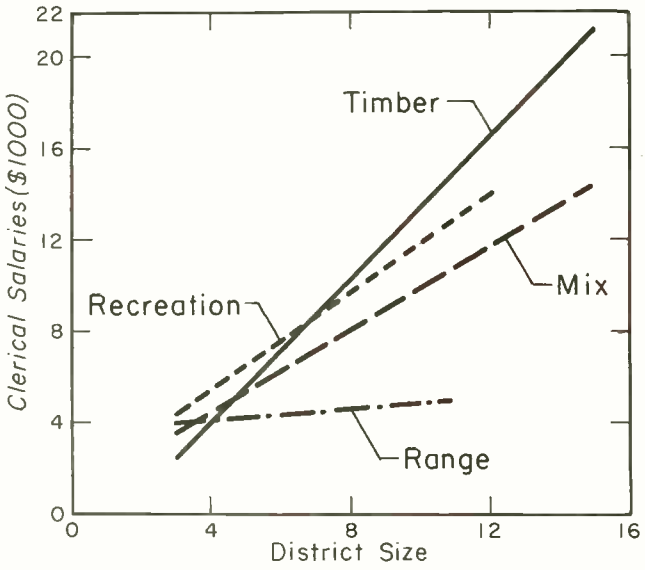


Figure 12. Clerical salaries versus District size.

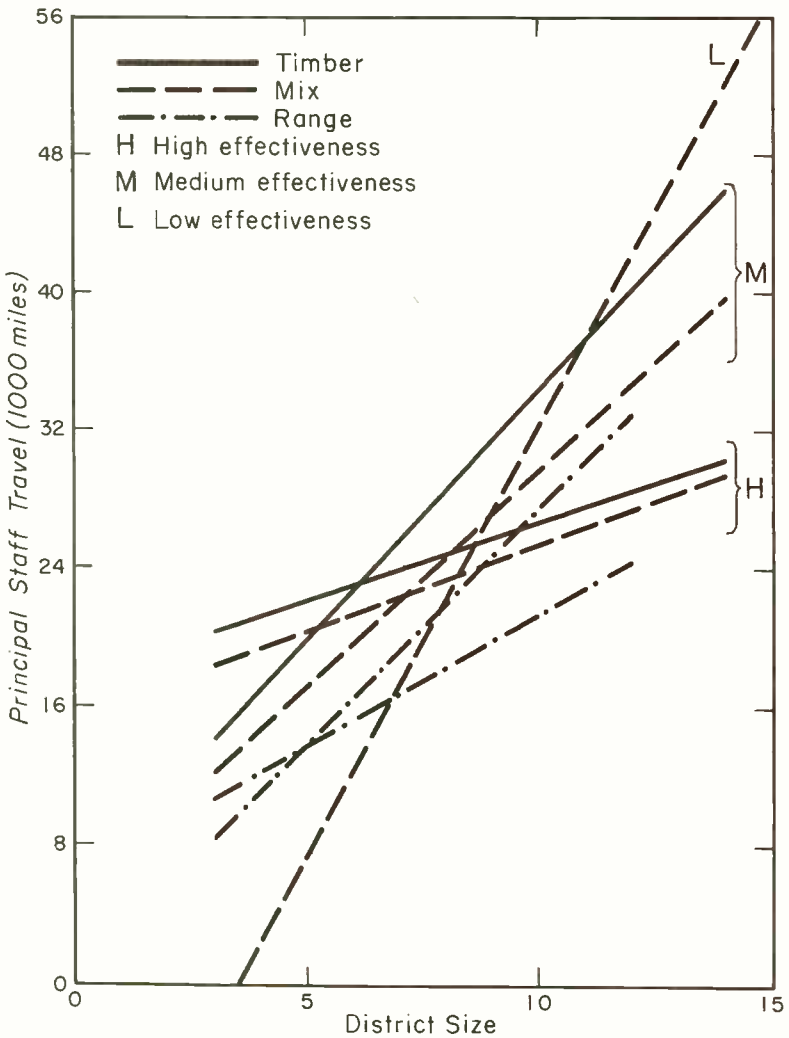


Figure 13. Principal staff travel versus District size by effectiveness groups.

ii. Conclusions

(i) For timber, recreation, and mixed functions districts, clerical costs per unit size increase at the same rate as district size. For range districts, clerical costs increase much slower than than district size due to the high positive intercept and because acres are a more prominent part of the size measure for range districts than budget or base time, but create less of a clerical workload.

(ii) Clerical salary cost is relatively small, and has little influence on total district staff salary cost which should remain the determining criterion.

(2.) Travel Costs

In these regressions travel is expressed in miles or dollars. We assume that travel cost is directly proportional to travel mileage so that travel mileage and dollars are interchangeable.

(a) District Ranger's Travel vs. Size

(i) Description and Conclusion

The District Ranger's travel mileage (and cost) is independent of district size for all functions. This finding is supported by the field study.

(b) Principal Staff Travel vs. Size

(i) Description

Positive linear relationships are shown in figure 13 separately for the high, medium and low effectiveness districts within each function for principal staff travel vs. district size. Although these relationships are of borderline statistical significance (5% and 10%), they are consistent.

From figure 13 it is apparent that each effectiveness level is a separate population and that, furthermore, the array of timber, mixed and range function remains fixed across effectiveness levels. The recreation function districts are not shown because, for them, travel is independent of size. The functional array supports predictions that for any given district size,

timber districts have the largest travel mileage followed by mixed, with range showing the least mileage. Of great interest is that the more effective districts for all functions, show less travel for any given district size above size 7 than the less effective districts. The high effectiveness districts have a positive regression slope of 1000 miles:1 unit size or less (1000 miles additional travel per unit of size increment); the medium effectiveness districts have a slope of approximately 2000:1, while the low effectiveness districts have a slope of 3000:1. (Only the mixed function regression was significant at the low effectiveness level.)

ii. Conclusions

(i) Principal staff travel mileage (and travel cost) for the timber, mixed and range function is directly proportional to district size.

(ii) Travel (for any district size) is lowest for range functions, followed by mixed functions, and highest for timber functions.

(iii) The larger the district size, the less the travel cost per unit size for the high effectiveness districts due to slopes and intercept. Travel cost per unit size remains relatively constant with size for the medium effectiveness districts and increases with size for the low effectiveness districts. (Figure 13A)

(iv) For districts larger than approximately size 7, the total travel cost for high effectiveness districts is lower than for medium and low effectiveness districts.

(v) Above approximately size 9, the total travel cost for medium effectiveness districts is lower than for low effectiveness districts.

(vi) For low effectiveness districts the total mileage increases twice as fast as in medium effectiveness districts, three times as fast as in high effectiveness districts for corresponding increases in district size.

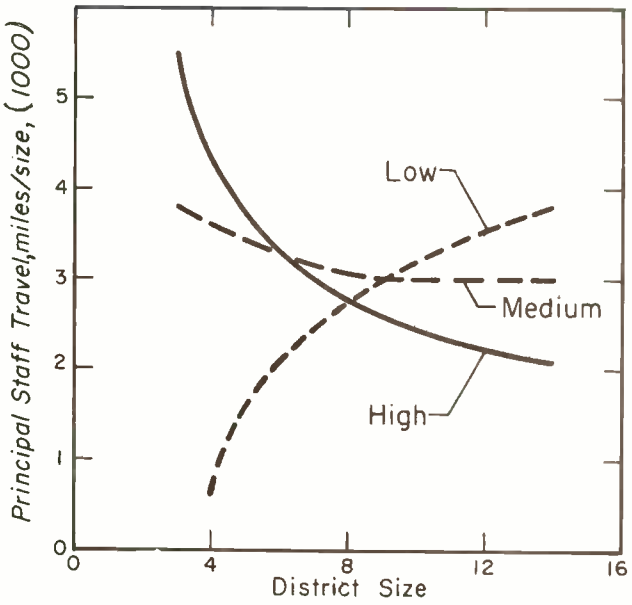


Figure 13A. Principal staff travel per unit size versus District size for low, medium and high effectiveness Districts averaged across functions

(c) Total Travel (District Ranger and Principal Staff) vs. District Size

i. Description

This relationship is significant (at 2.5% level or better) for timber, mixed, and range functions with a positive linear relationship of slightly less than 1000 miles:1 unit size, see figure 14. (The effectiveness levels have not been shown separately.) Since the District Ranger's travel is independent of size, adding it to the staff travel reduces the dependence of total travel on size.

ii Conclusions

(i) Total district staff travel (Ranger plus principal staff) for mixed, timber, and range functions, is linearly related to district size.

(ii) Increase in travel mileage is slightly less than 1000 miles:1 unit size. Due to the positive intercept total travel mileage does not increase as fast as district size.

(d.) Ranger and Staff Travel vs. District Acreage

i. Description and Conclusions

Travel costs appear to be independent of district acreage. This is probably true because acreage alone does not identify intensity of management and its consequent staffing and travel requirements.

Ranger plus staff mileage, as well as Ranger's mileage alone, is independent of district acreage.

(e.) Ranger and Staff Travel vs. District Budget

i. Description

Since budget is a fair reflection of workload and workload in turn requires travel, travel would be hypothesized to be positively related to budget. This hypothesis is verified as shown in figure 15 for timber, mixed, and range districts (at the 0.5% significance level). For timber and mixed functions, the regression line slopes slightly less than $1 travel:$100 budget.

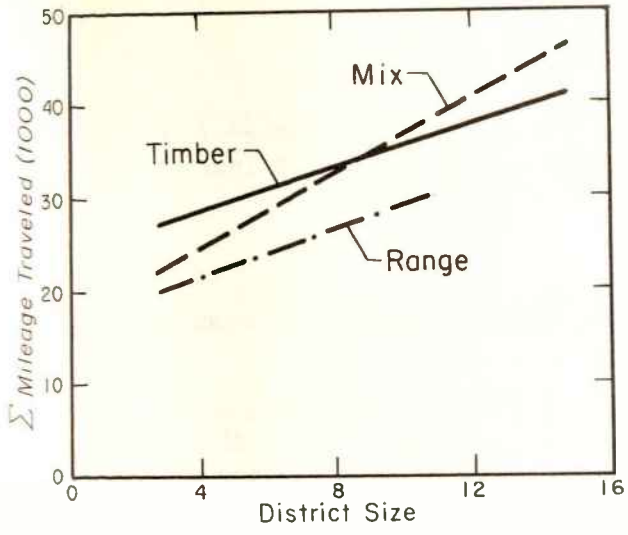


Figure 14. Total miles traveled (Ranger and staff) vs. District size by primary function.

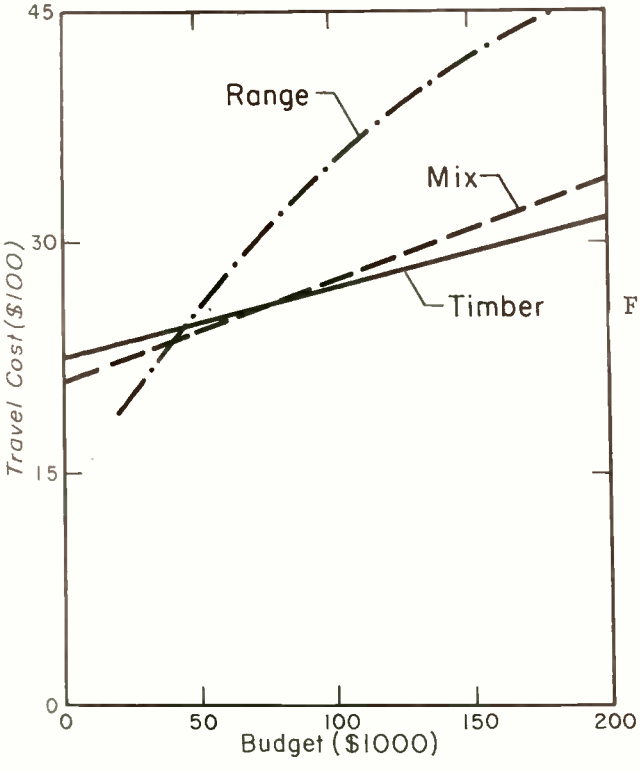


Figure 15. District Ranger and staff travel cost versus budget by primary function.

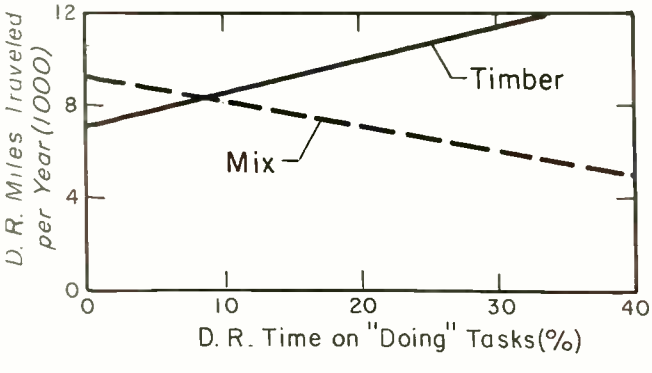


Figure 16. District Ranger travel per year versus time spent on "doing" tasks by two primary functions.

For the range function, the curve is quadratic -- almost linear up to a budget of $100,000 and increasing at much lesser rate after about $160,000.

ii. Conclusions

(i) Travel cost for the Ranger and staff is dependent upon district budget.

(ii) For timber and mixed districts, the relationship is linear with a slope less than 1:100. Also, the intercept is positive. (This is consistent with the travel cost vs. district size discussed above.)

(iii) For range districts, the relationship is quadratic with less than proportional travel costs for the larger districts, i.e., those budgeted above $100,000.

(f) District Ranger and Staff Travel Cost vs. Longest Time to Travel to a Major Work Area

i. Description and Conclusions

Travel cost is independent of longest time to travel to major work areas. This suggests that some distant major work areas are visited less, or are an insignificant portion of total travel, or travel is better planned on districts with far flung work areas.

(g) District Ranger Travel vs. Percent of Ranger's Time Spent on Production Tasks

i. Description

Even though the District Ranger's travel was found to be unrelated to district size (Section 2a) and even constant for all sizes of district (see Field Study) it was postulated that the ranger's travel might be a function of the amount of time he spends on production tasks. Only the timber districts provided a strong and significant (1.0% level) positive linear relationship. (Figure 16) On the other hand, the mixed districts indicated a linear negative relationship with a weaker significance (5% level) so that no strong conclusion can be drawn.

(4) Overhead Costs

(a) Overhead Costs vs. District Size

i. Description

Overhead costs consist of: facilities (except equipment) rental, utilities (water, electricity, gas, sewage, etc.), the clerk's salary. The relationship of overhead costs vs. size is shown in figure 17. The dependence of overhead cost on district size is highly significant (at the 0.5% level) for all district functions. The greater the district size, the greater the overhead cost.

Because of the positive intercept, and shallow slope for the range and mixed districts, economies of scale are apparent, i.e., the overhead costs increase less rapidly than district size. This is supported by figure 18 where overhead cost is plotted on a per unit of size basis showing a significant second degree curve, which flattens out approximately at district size 10-11 for both functions. While it is hypothesized that there may exist a district size beyond which overhead costs become larger per unit of District size. such a point has not been reached within the size range of our data. Figure 18 shows that the average rate of decrease in overhead cost per size is markedly less after size 11 is reached for mixed districts. (The overhead/size vs. size regression curves for the recreation and timber districts were not significant.)

ii. Conclusions

(i) Overhead costs for mixed and range districts do not increase as fast as size increases.

(ii) Overhead costs for timber and recreation districts increase at about the same rate as size increases.

(iii) For mixed districts, the overhead costs, per size, tend to decrease at a reduced rate after size 10-11 is reached.

(iv) There exist economies of scale for overhead costs for mixed and range districts.

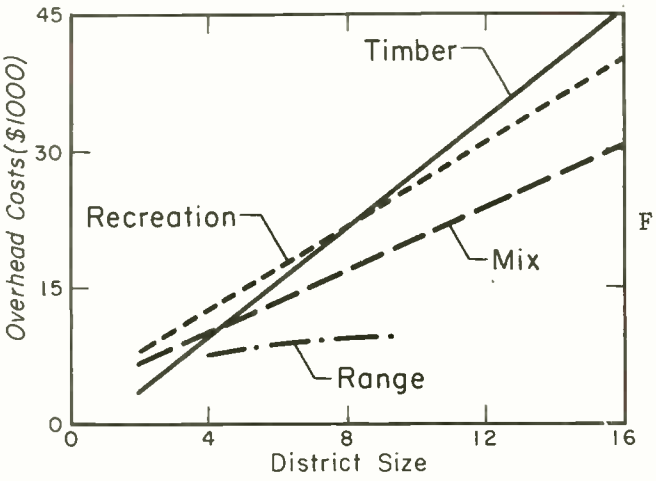


Figure 17. Overhead cost versus District size by primary function.

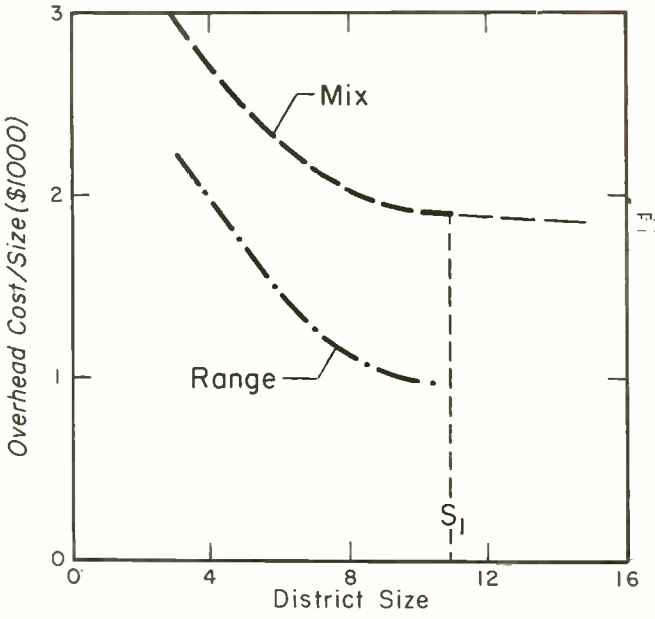


Figure 18. Overhead cost per size versus District size by two functions.

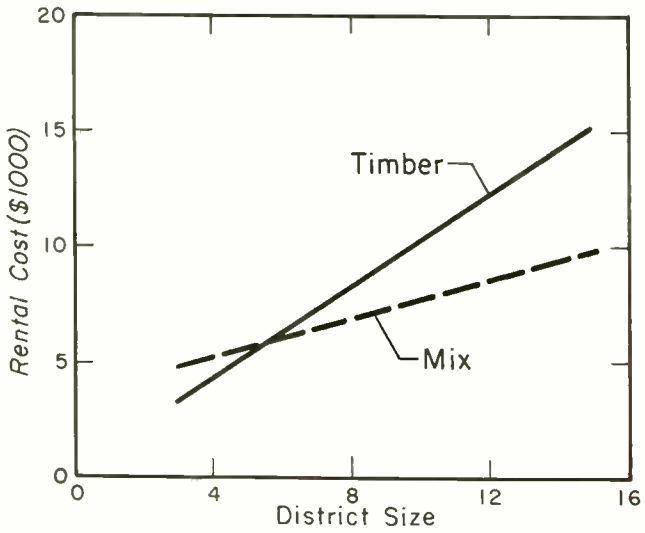


Figure 19. Rental cost versus District size by two functions.

(b) Rental Costs vs. Size

i. Description

Rental costs are defined as the rental or ownership cost for offices, warehouses, and shops forming part of the district headquarters. Rental costs were plotted vs. district size as shown in figure 19. There is a highly significant (at 0.5% level) linear relationship for the timber and mixed districts. For the timber districts, rental costs increase in direct proportion to size; for the mixed districts, they increase only half as fast as size due to positive intercept. For recreation districts, the relationship is similar to the mixed districts but the data points were too few for significance. There is no relationship for the range districts.

ii. Conclusions

(i) Rental cost is linearly dependent on district size for timber and mixed districts.

(ii) For mixed districts, the rental cost increases less than the proportional increase in district size.

b. Miscellaneous Regressions

(1) District Budget/Size vs. Size

(a) Description

This analysis tested whether the larger districts are funded at a lesser rate per unit size than the smaller districts. This was expected since salary, travel and overhead costs decrease per unit size as size increases.

Only the timber and recreation functions yielded significant (at the 0.5% and 2.5% levels respectively) relationships, see figure 20. The dependence is linear and positive, refuting the hypothesis. Apparently the larger districts have proportionately more project money allocated than the smaller districts. Independence of the variables was hypothesized for the range districts because acreage is the major size component of range districts which is relatively uniformly

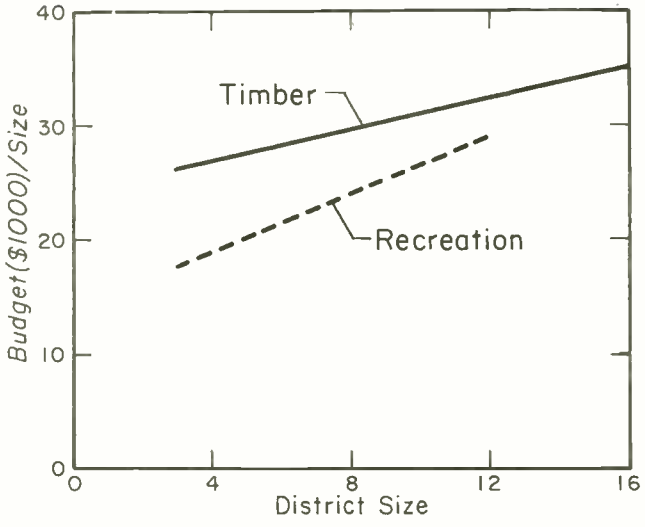


Figure 20. Budget per size versus District size by two functions.

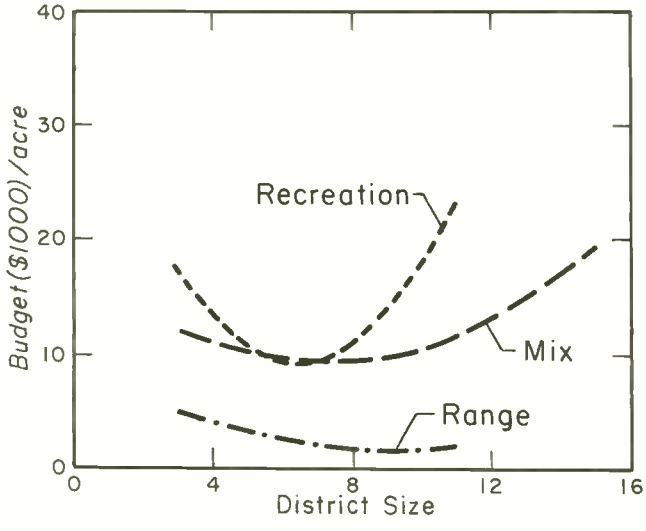


Figure 21. Budget per acreage versus District size by primary functions.

budgeted. This independence is supported by results of the test.

(b) Conclusions

i. For timber and recreation districts, budget per unit size increases as size increases showing the heavy allocation of project monies for the larger districts.

ii. For range and mixed districts, budget and size are independent.

(2) Budget/Acre vs. Size

(a) Description

It was hypothesized that budget/size was dependent on size. Since acreage is one element of the size measure, it was hypothesized that for small and medium sized districts there would be a small budget/acre while for the larger sized districts there would be a relatively large budget/acre since the larger districts more often tend to be intensely managed districts with small to medium acreage. It was further hypothesized that the range function would show the smallest budget/acre over all district sizes while the timber and recreation functions would have the highest budget per acre over all sizes (Figure 21). All relationships were quadratic, except for timber districts which was not significant. The range and recreation functions were significant at the 0.5% level and the mixed function at the 2.5% level. The hypotheses were supported in that the range function is budgeted lowest per acre and the recreation function highest over all sizes. The sharp increase of budget/acre for larger size values supports the hypothesis but the U shaped curve was not predicted. The minimum budget/acre occuring between sizes 6-9 is probably not of major consequence.

(b) Conclusions

i. Budget/acre is strongly dependent on size.

ii. The budget/acre is least for medium sized districts (sizes 6-9) and grows rapidly as size increases above 12.

(c) Range districts have lowest budget per acre and recreation the highest.

(3) Base Workload/Size vs. District Size

(a) Description

Base workload is one of the three elements of the size measure. It was, therefore, hypothesized that base workload/size is negatively correlated with district size. Separate regression curves were calculated for the three levels of effectiveness (high, medium, and low) of each of the four district functions. All were significant. The high effectiveness timber function and the high and low effectiveness range functions were also fitted quadratically -- all others were fitted only linearly. The linear regressions clustered close to each other with an average slope of 25:1 (i.e., for every unit increase in size, there was an average reduction of 25 hours base time/unit of size) figure 22. For a size 5 district the average base time/unit size was 596, while for a size 10 district the average base time/unit size was 424. Only the medium effectiveness range districts had an essentially different regression line with a slope of 90:1.

The high effectiveness timber districts and all range districts were also fitted with a quadratic regression curve significant at the 0.5% level as in figure 23. Of interest is that for the range districts a low of approximately 500 base workload hours/unit of district size occurs after size 9. Larger district size would probably show further decreases in the base time hours/size ratio. This is at the upper end of the size population of range districts. The curve for timber continues to decrease within the range of observed district sizes.

(b) Conclusions

i. As predicted, base time/unit of district size decreases with increasing district sizes.

ii. A linear approximation to this regression is generally sufficient, with an average negative slope of 25:1.

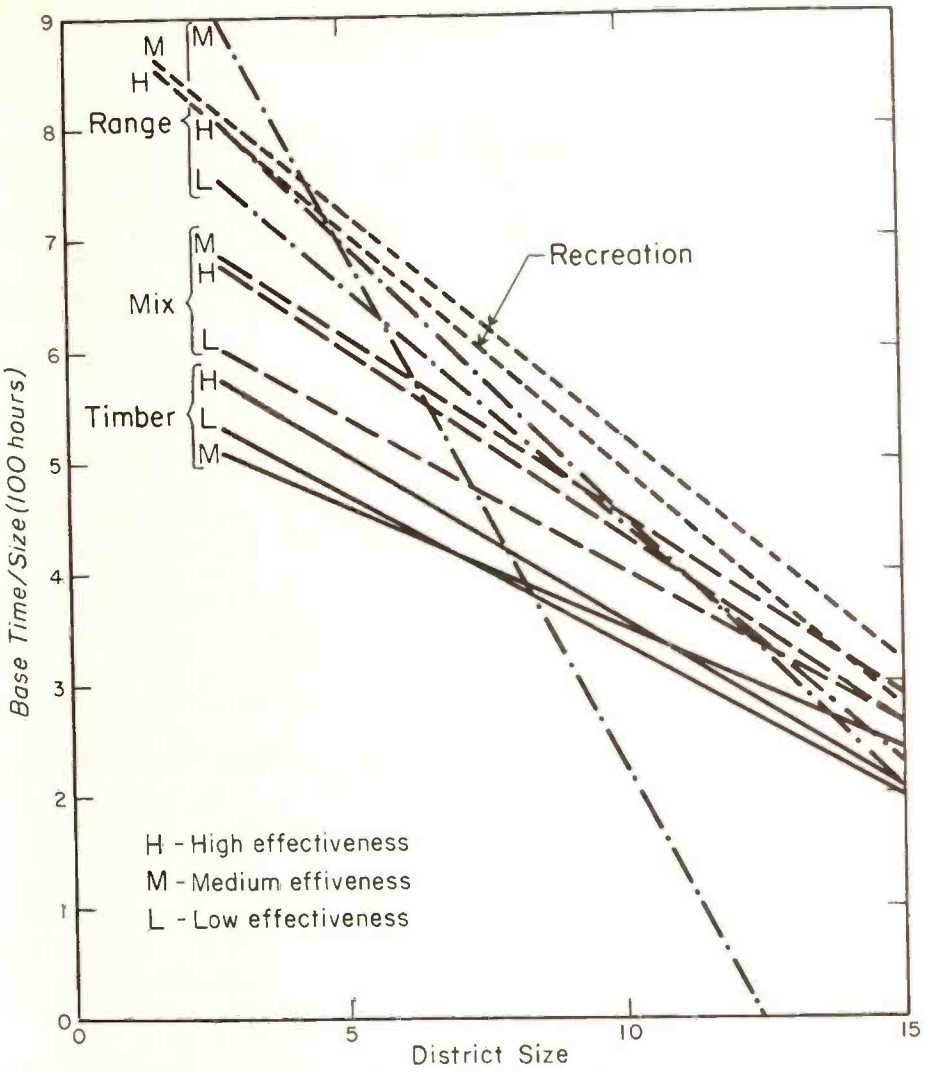


Figure 22. Base time per size versus Dist. size by primary function and effectiveness groups.

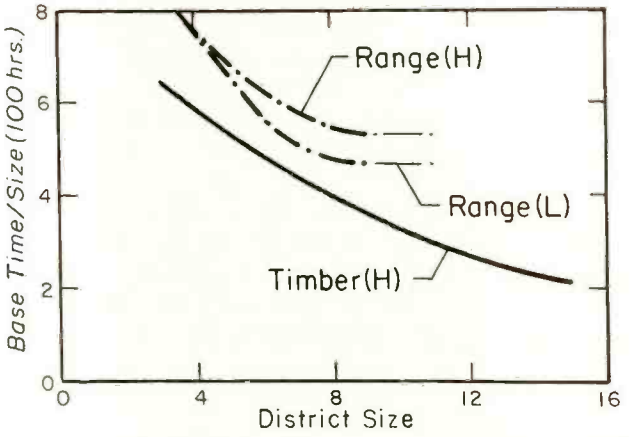


Figure 23. Base time per size versus Dist size by primary function for indicated effectiveness groups

iii. For the high and low effectiveness range districts a quadratic curve could be fitted reaching 500 hours base time per unit size at size 9, which is near the extreme of the range district size population.

(4) Percent of Time the Rangers Spend on Production Tasks vs. District Size

(a) Description

Most of the participation in production tasks is in the 5-15% range (only 10% variation) for all functions and effectiveness levels giving this whole discussion probably more academic than real significance. Another caution must be expressed in this analysis. The data regarding Ranger's production tasks is based on monthly work plans, frequently so sketchy as to preclude precise determination. The reliability of the data is therefore open to question.

This analysis tests the hypothesis that Rangers on small districts spend a relatively larger part of their time on production tasks while Rangers on large districts spend little time on these tasks being almost completely occupied by management duties. The tests support the hypothesis but only for the low effectiveness districts. Rangers on range and timber districts (low effectiveness) have indeed a negative linear regression with about 20% of their time devoted to labor activities for very small districts to less than 10% devoted to these tasks for districts larger than size 10.

The hypothesized relationship is not supported for high effectiveness districts. The range and mixed districts yielded significant quadratic curves at the 0.5% and 2.5% level respectively showing that for the very small and very large size districts the Ranger spends a greater percentage of his time on labor tasks than he does in the medium sized districts. For the range districts a minimum of 8.5% of Rangers' time on production tasks is reached at size 6, while for the mixed, the minimum point is at size 10 with 3.5%. (See figure 24) This suggests that even the Rangers on the largest districts participate in production tasks and keep their field knowledge current. This is more apparent for the Rangers on the more effective districts than for those on the less effective districts.

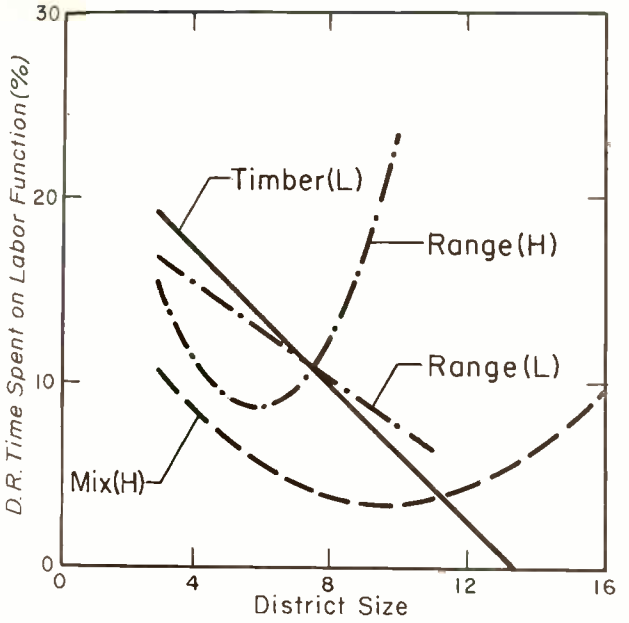


Figure 24. Percent of District Ranger time spent on "doing" work versus District size by indicated effectiveness.

(b) Conclusions

i. For the less effective districts (range and timber are significant) the percentage of time used by the Ranger to participate in production activities decreases linearly with size of district from a high average of 18% for very small districts to a low average of less than 10% for larger districts.

ii. For the more effective districts (range and mixed are significant) a minimum is reached for medium sized districts and higher amounts of production participation is recorded for the smaller and the larger districts.

C. VALIDITY OF MEASURES OF EFFECTIVENESS

The validity of a measure refers to its ability to evaluate the specific characteristic under study. The District characteristics subject to evaluation were the District production outputs of a service or a product, or both. Thus, our measures of operational effectiveness were intended to assess the degree of effectiveness with which these outputs were produced, based only on these outputs. How closely this intent was satisfied determines the validity of our measure of effectiveness. We fully realize the limitations of this concept of effectiveness, but a valid definition of organizational effectiveness has, so far, defied all researchers.

A conclusive test of the validity of our measures of effectiveness would require a comparison with objective measures of accomplishment if such measures were available for the whole spectrum of the District's activities. As noted in Chapter V, this is not the case even for limited functional areas such as timber management for which cut and sold accomplishment constituted one objective measure of accomplishment. Nevertheless, such comparisons were made for the available objective measures because of the possible positive evidence of validity which they may contribute. The tests for correlation between cut and sold accomplishment and timber management effectiveness, and range allotment inspection versus range management effectiveness, yielded no significant correlations.

An indirect assessment of the validity of our measures of effectiveness is based on:

1. Internal consistency.
2. Relationship to characteristics presumed to be related to operational effectiveness.
3. Evidence of contamination by extraneous considerations.

Our data show a significant correlation between the preliminary over-all evaluation of effectiveness and the composite and primary function effectiveness evaluation. ("T_b" contingency coefficient equals .42 and .40 respectively). Since these were obtained by very different methods, and reflect a refinement of the (undifferentiated) preliminary evaluation, these correlations reflect the internal consistency of the measures of effectiveness. The consistency of the measures of effectiveness is also reflected in the trends evident for the various operational categories and their agreement with the known aspects of the situation. As an example, fire control presents a different relationship to size than the other functions measured (table 3). This circumstance does agree with what is known of the special management aspects of the fire control job.

Among the characteristics which can be presumed to be related to District effectiveness are the professional competence of Ranger and

staff. The data show a high degree of correlation between the measures of District effectiveness and this variable. Such correlation would be expected of a measure of District effectiveness, but it is also possible that this correlation is the result of basing the effectiveness evaluation, in part, on the extraneous consideration of the professional competence of the Ranger and his staff.

The cost relationships discussed in Part C show evidence that the more effective Districts have more favorable characteristics with regard to various operational costs. Since District effectiveness has been shown to be only slightly correlated with District size, and the District effectiveness evaluation involved cost considerations only secondarily, this circumstance can be counted as strong evidence in favor of the validity of our measures of effectiveness. Similarly, the finding that Ranger participation in production tasks varies with size only for the less effective Districts relates satisfactorily to our concept of effectiveness and the high correlation of effectiveness to Ranger competence.

Section B presents evidence of contamination of the preliminary overall District effectiveness evaluation by extraneous considerations, such as size of District and the number of professionals on the District.

We thus can summarize our findings by saying:

1. There is indirect evidence to support a view that the structured (2nd questionnaire) measures of effectiveness provide a valid (within the limitations of this study) assessment of District effectiveness. These evaluations, however, may be based, in part, on the professional competence of the Ranger and his staff.

2. The preliminary evaluation of effectiveness is based, in part, on District characteristics other than District effectiveness, such as District size and District staffing levels.

D. SIMULATION

1. Relationship of Cost to Changes of District Size

For the 79 sample combinations (refer to page 25), we computed the net change in operating costs resulting from pair-wise District combinations. The relationship of this change in cost (a negative net change denotes a saving) to size after combinations was expressed by means of linear regressions (figure 25). A significant (1% level) negative relationship exists between savings of $2000 or more and size after combination with no savings, on the average, for combined Districts larger than size 14. An average saving per combined size can be read from this graph. It is, for example, 7.8 thousand dollars per year for combined District size 6. Decision rules for District size change should reasonably assume annual savings for a period of at least ten years. Consequently,

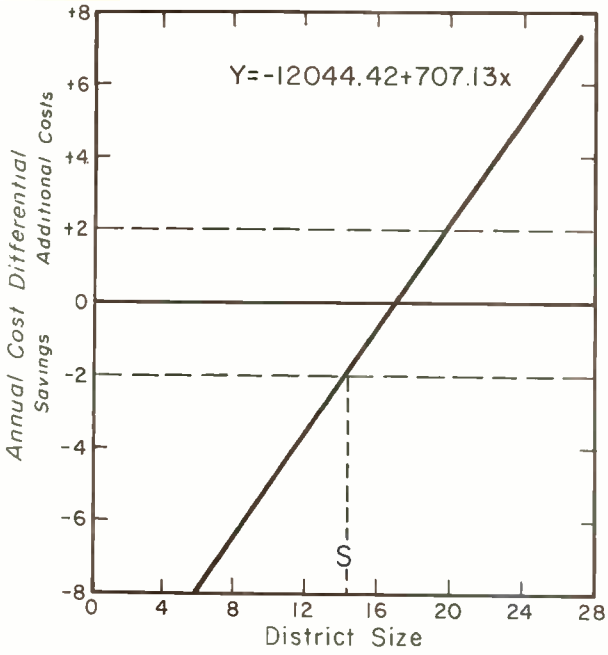


Figure 25. Seventy-nine District Combinations. Annual cost differential versus 1967 District size.

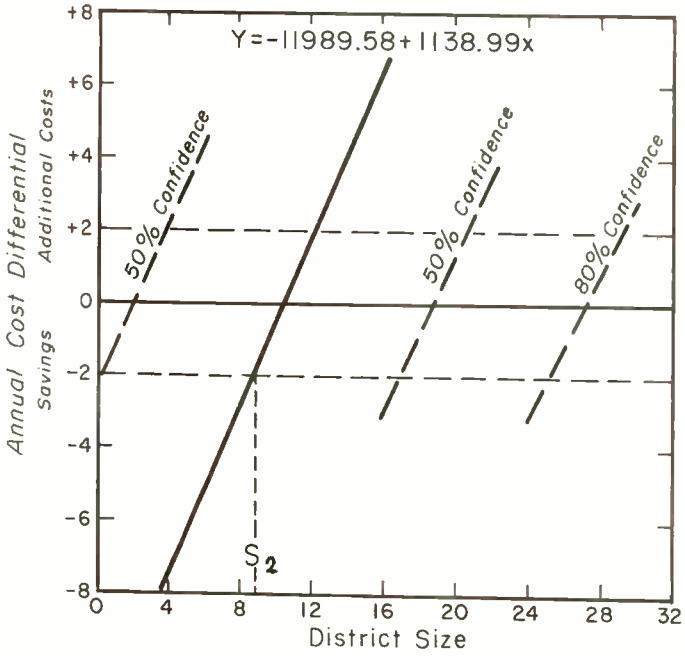


Figure 26. Seventy-nine District Combinations. Annual cost differential (projected 10 years) versus 1967 District size after combining. Confidence bands apply to single new combination.

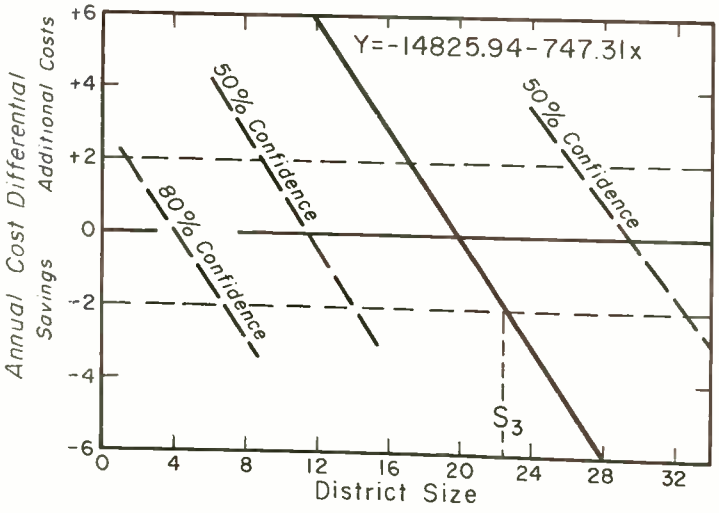


Figure 27. Seventy-two District Splits. Annual cost differential versus District size prior to splitting. Confidence bands apply to single new split.

it is necessary to consider the growth of the Districts, and the effect this would have on the potential for savings. The net changes in cost were, therefore, re-computed on the assumption that the budget for each District would double in the next 10 years, and the base workload would increase by 50 percent during the same period. A new line was fitted for these data which showed a similar negative relationship between present combined District size and savings (figure 26). From this figure, we conclude that for a combined District larger than present size 9, no savings can be expected, on the average, after 1977, because a size 9 District is assumed to grow, on the average, to size 14 by 1977.

Similar regression lines were fitted to the net cost charges for the 72 Districts which constituted our sample for District splits (figure 27). In this case, the relationship was positive, with savings realized, on the average, when splitting Districts larger than size 22.

Splits were not projected into the future because it would appear unreasonable to split a District today at an added cost in anticipation of savings sometime in the future. If a split results in savings today it is because travel time has been significantly reduced on either one or both halves of the original District. This reduction in travel would continue in the future.

If the criterion for making splits is savings, then the time to split a District is at the time savings would occur because District growth will further enhance the savings.

The probabilities of realizing savings from splitting a District, or through combination of a District pair of a given combined size, are shown in figure 28. These were obtained by the method described in part V.C. from confidence bands about the regression lines (figures 26, 27) fitted to net cost change versus size and are appropriate for the $2,000 level of savings. The curves show that the probability of savings through the combination of two Districts with a present combined size 6 is considerable (approximately 60 percent), and is still nearly 40 percent for Districts whose present combined size is 12. It should be noted that the probability of realizing a saving is still approximately 15 percent even for a present combined size 22. However, the probability of reducing costs by splitting a size 22 District is nearly 50 percent. While in a few instances savings can be realized by combining large Districts, more often the advantage will be in a reduction in size. The point at which a probability equilibrium is reached is size 16. The optimum size range recommendations are based in part on these results, with the upper limit of this range at the point above which the probability of realizing a saving by splitting is better than 50 percent. Similarly, below the lower end of the recommended range, combinations

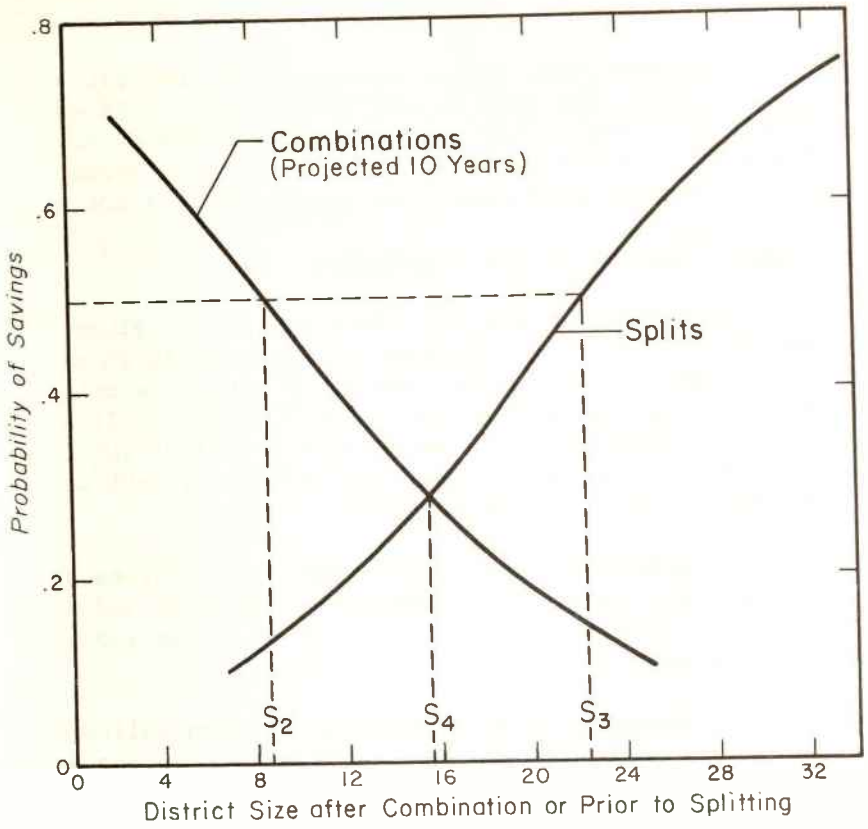


Figure 28. Probability of Saving $2000 or more per year as a result of combining or splitting Districts.

resulting in size nine or less have better than a 50 percent probability of realizing savings in 1977, and even higher chance today. Since it can be expected that the probabilities of realizing savings by multiple rearrangements of Districts would be even higher than those shown, the lower limit of the recommended size range can be regarded as conservative.

2. Extension of Sample Results to the Population

As discussed on page 25, there are 620 Districts in the eight Regions adjoining in groups of at least two. Without any consideration of feasibility other than geographical proximity, these 620 Districts could--in theory--be combined in groups of two to yield 310 Districts. It should be emphasized that this represents only the consolidation of two Districts into one. It does not consider other possibilities such as one District being absorbed by two or more Districts.

A final sample of 67 potential combinations was selected, as described on page 25, from the total 310 combinations for detailed cost analysis. Thirty-one (46 percent) of these 67 potential combinations showed annual savings of over $2,000.

To extend the sample findings to the population of nonduplicate pairs, the distribution of sizes for the population of pairs was assumed proportional to the distribution of sizes for the sample pairs, smoothed by grouping the number of District having three consecutive size measures (e.g., 2, 3, and 4, etc.) into a single group. The probability of realizing a projected saving equal to or larger than a specified dollar amount for a given size group, respectively, was read from curves similar to Fig. 28 and applied to the distribution of size groups. Since these curves give the exact probability level for a single combination only, the resulting estimates in Table 9 are only approximate. The data from Table 9 have been plotted in Fig. 28A for interpolation. This curve should not be extrapolated beyond $16,000.

Even though socio-political factors were not considered in selecting headquarters for the combined Districts, they may well be among the most important considerations deciding whether to combine or not.

3. Variables Affecting Cost When Size is Changed

a. Headquarters location

When two existing District have headquarters located in the same town, they should be considered for possible combination because, regardless of size, the probability of realizing savings for such a combination is 87 percent.

b. Travel

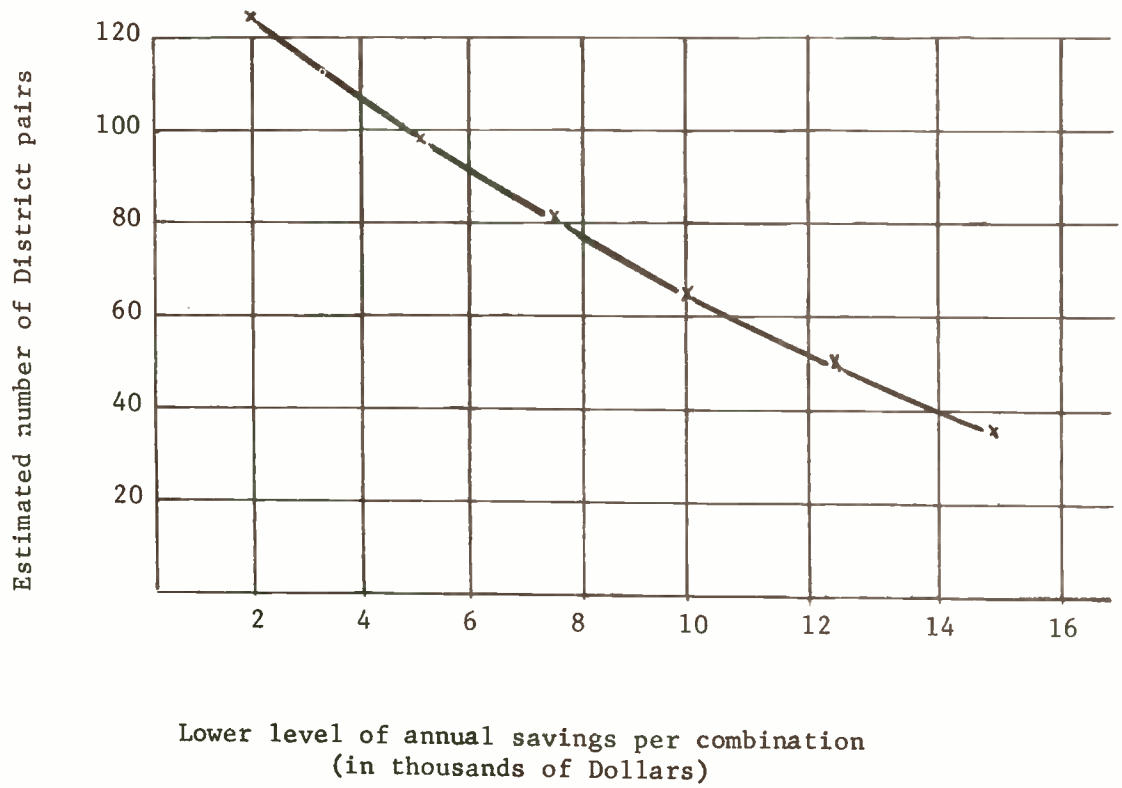
The most sensitive factor determining the change in net cost was found to be associated with travel patterns. Figure 29 shows the relationship between cost change and change in travel time due to change in headquarters location.

ble 9. --Estimate of number of District pairs which, when combined, yield savings above the specified levels (10-year projection)

ANNUAL SAVINGS IN DOLLARS PER COMBINATION	NO. OF DISTRICT PAIRS WHICH CAN BE COMBINED 1/
2,000 and over	123
5,000 and over	98
7,500 and over	81
10,000 and over	65
12,500 and over	51
15,000 and over	37

1/ These estimates are derived from a simulation with only geographical constraints. Reality imposes many other constraints.

Fig. 28A
Estimate of number of District pairs which, when combined, yield savings above the specified levels.



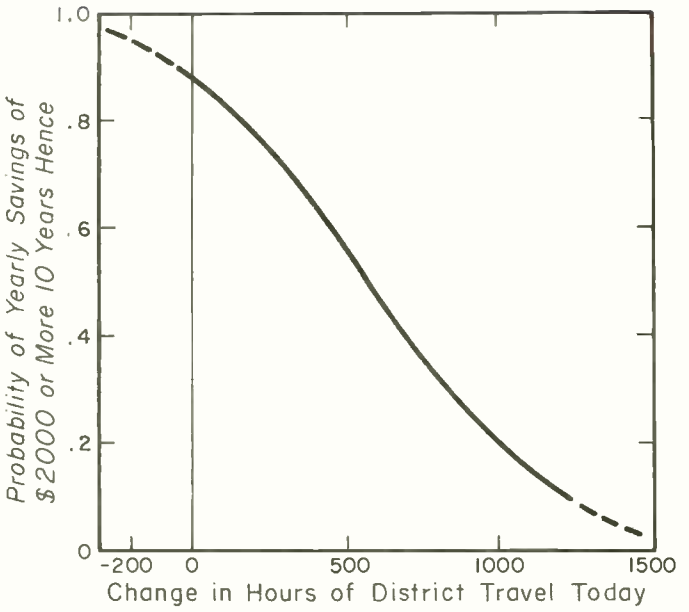


Figure 29. Seventy-nine District Combinations. Probability of saving $2000 or more per year 10 years hence when change in hours of District travel is known today.

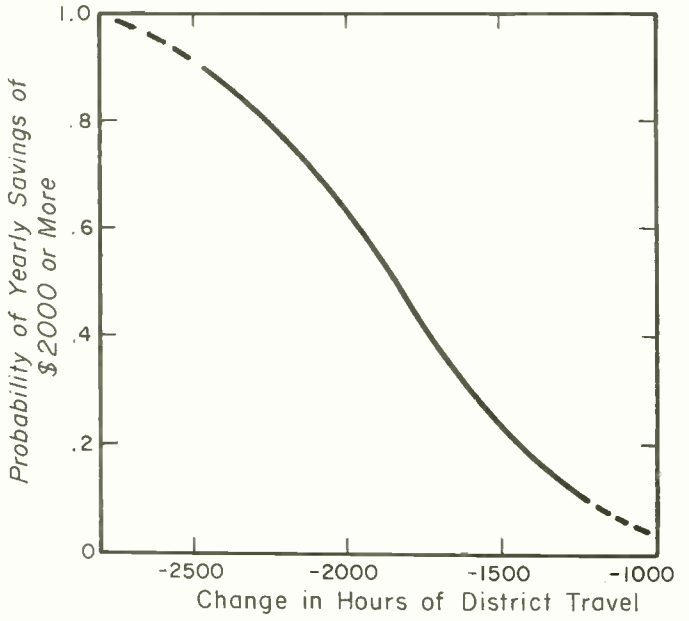


Figure 30. Seventy-two District Splits. Probability of saving $2000 or more per year when change in District hours of travel is known.

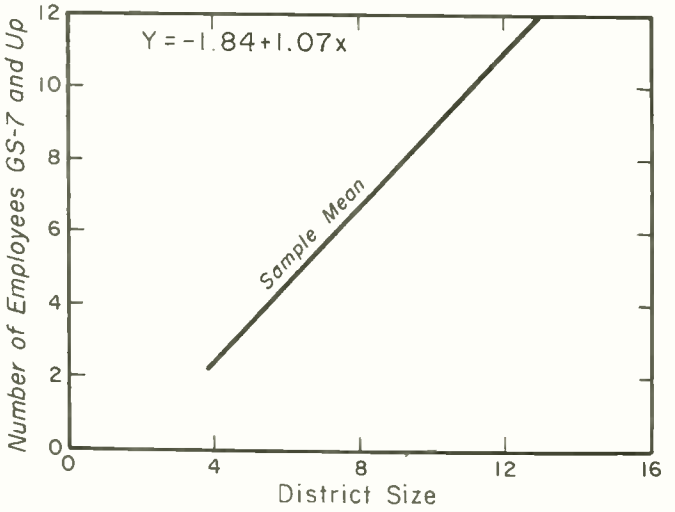


Figure 31. Number of people with grade GS-7 and up based upon District size (147 Districts)

Figure 29 can be used as a guide in setting priorities for detailed cost analysis of pairs of Districts for combination.

If a preliminary check shows that as a result of combination the expected hours of travel on the District will be reduced, or remain constant, then the probability of making annual savings for at least a 10-year period is 87 percent or better. If the proposed combination results in 580 added hours of travel, the probability drops to 50 percent. Thus, early efforts of analysis can be channeled to the more probable successes. However, combinations resulting in more than 580 hours of added travel can also yield savings. (One sample combination resulted in annual savings of $3,301 for a 10-year period in spite of increased annual District travel time of 702 hours.)

Figure 30 can be used similarly for setting priorities in splitting Districts. The probability is 50 percent for saving $2,000 or more per year for a District split when District travel is reduced by 1840 hours. Savings or costs for splitting Districts were not projected for a 10-year period.

c. Number of Employees with grade GS-7 or higher.

Other findings in this study suggest four GS-7 (or higher) as minimal manning (Ranger and staff) for a District. Figure 31 shows that, on the average, a District size 6 or larger has the requisite number. A combination of existing Districts which results in a combined size 6 has a 59 percent probability of showing $2000 annual savings for at least the next 10 years.

d. Non-significant variables.

The following variables apparently do not affect the success of District size change:

(1) Total number of employees
(2) District acreage
(3) Miles traveled per trip

4. Characteristics of Sample Combined Districts Showing Annual Savings of $2,000 or More.

Table 10 shows the distribution of combinations showing savings today, and table 11 shows those showing savings 10 years

Table 10. --Non-duplicate consolidated sample Districts showing savings from simulation today (1967)

Region	No. of Districts by Primary Function				
	Timber	Mixed	Range	Recreation	All
1	2		2		4
2		2	5	2	9
3		4	1		5
4		2	3		5
5		3	1	1	5
6	2	2			4
8	7				7
9	4	2	1		7
All	15	15	13	3	46

Table 11. --Non-duplicate consolidated sample Districts showing savings from simulation for a projected 10-year period (1977)

Region	No. of Districts by primary function				
	Timber	Mixed	Range	Recreation	All
1			1		1
2			4	1	5
3		3			3
4		2	2		4
5		2	1		3
6	2	1			3
8	6				6
9	3	2	1		6
All	11	10	9	1	31

hence. Figures 32 and 33 show the distribution of the combination sample by District size and acreage, respectively.

The salient points are:

Forty-six non-duplicate combinations show yearly savings ($2,000 or more). This represents 69 percent of the 67 non-duplicate sample combinations. However, when growth is projected for a 10-year period, those combinations with $2000 yearly savings represent only 46 percent of the sample, or 31 Districts. Only 4 of the 31 sample combinations exceed the upper bound of the existing size range of the 147 Districts in the sample (figure 32).

None of the 31 sample combinations have an acreage which exceeds the upper bound of the range of the 147 Districts in the sample (figure 33).

5. Characteristics of Sample Split Districts Showing Annual Savings of $2,000 or More

Figure 34 shows the distribution by size of the 51 Districts selected randomly from the 147 previously described which were split, and the additional 21 Districts drawn randomly from the 79 combinations. Only one of the 51 Districts drawn from the original 147 showed savings of over $2,000 when split, while 7 of the 21 combinations showed savings of over $2,000 when split. None of the seven combinations had shown savings of $2,000 or more as a result of combining either on the basis of today, or projected for a 10-year period. Size of the Districts showing savings were:

Number of Districts	Size Prior to Splitting
1	8
1	9
1	11
2	12
1	14
1	18
1	19
8	

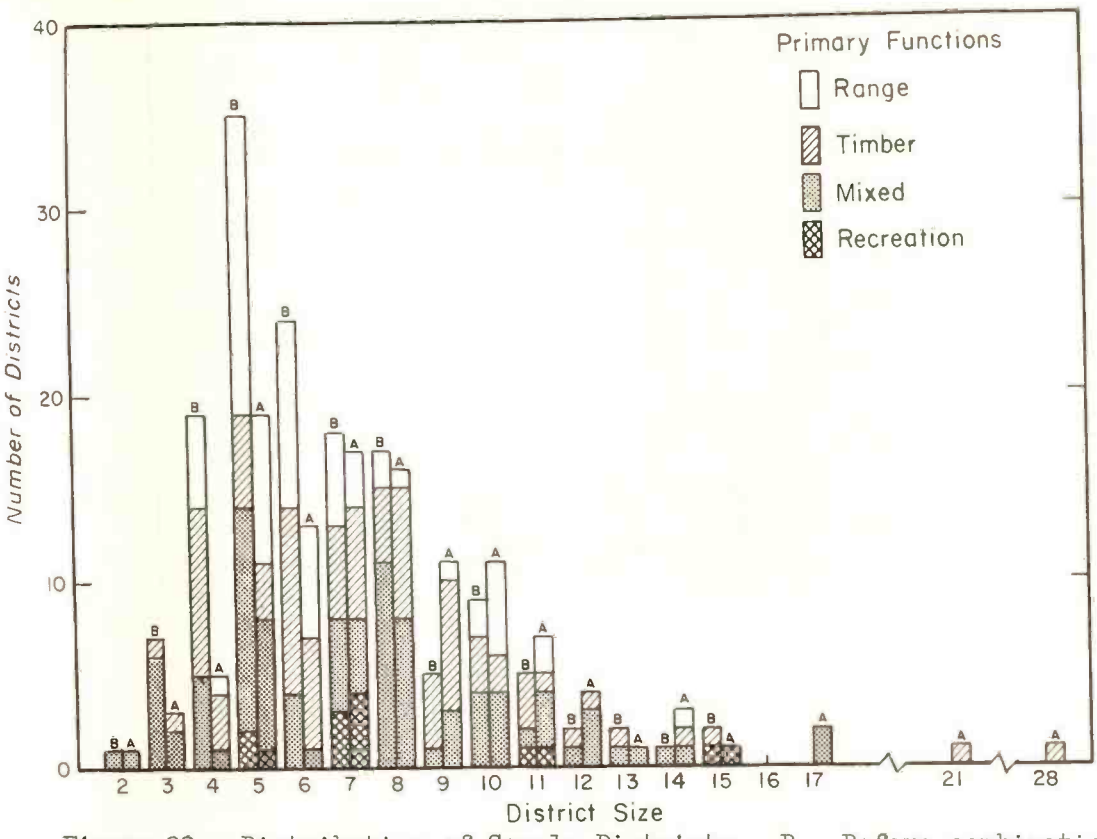


Figure 32. Distribution of Sample Districts. B - Before combination (147 Districts) A - After combination (116 Districts).* Only those combinations were made which showed projected $2000 savings for 10 years.
*Combined and undisturbed Districts.

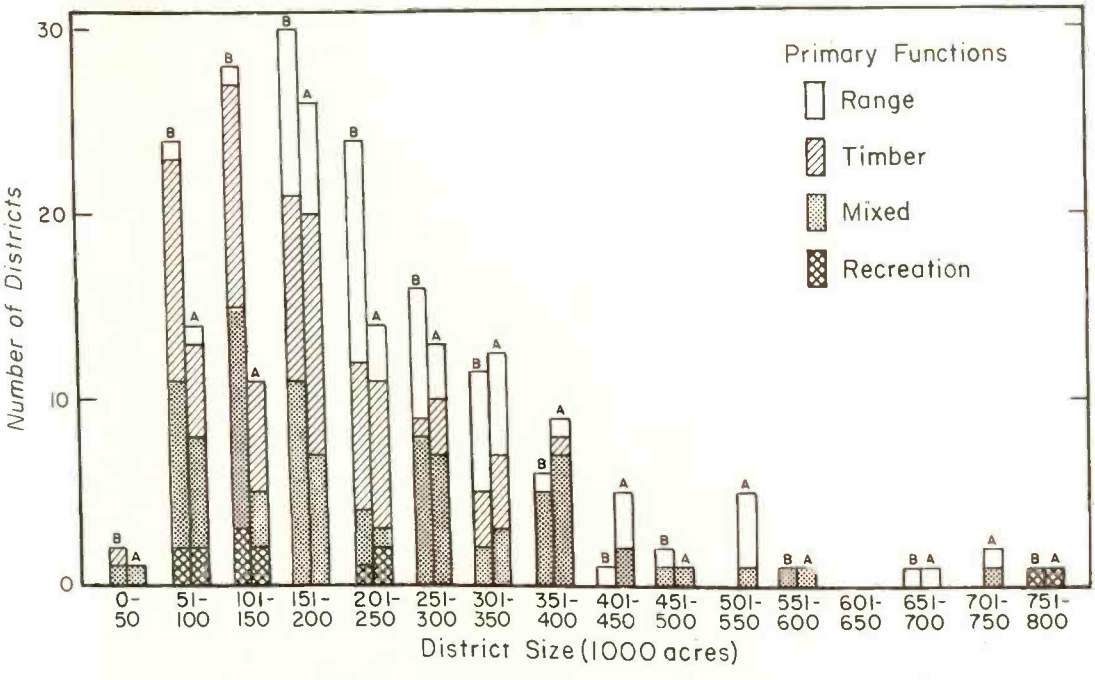


Figure 33. Distribution of Sample Districts. B - Before combination (147 Districts) A - After Combination (116 Districts).* Only those combinations were made which showed projected savings for 10 years.
*Combined and undisturbed Districts.

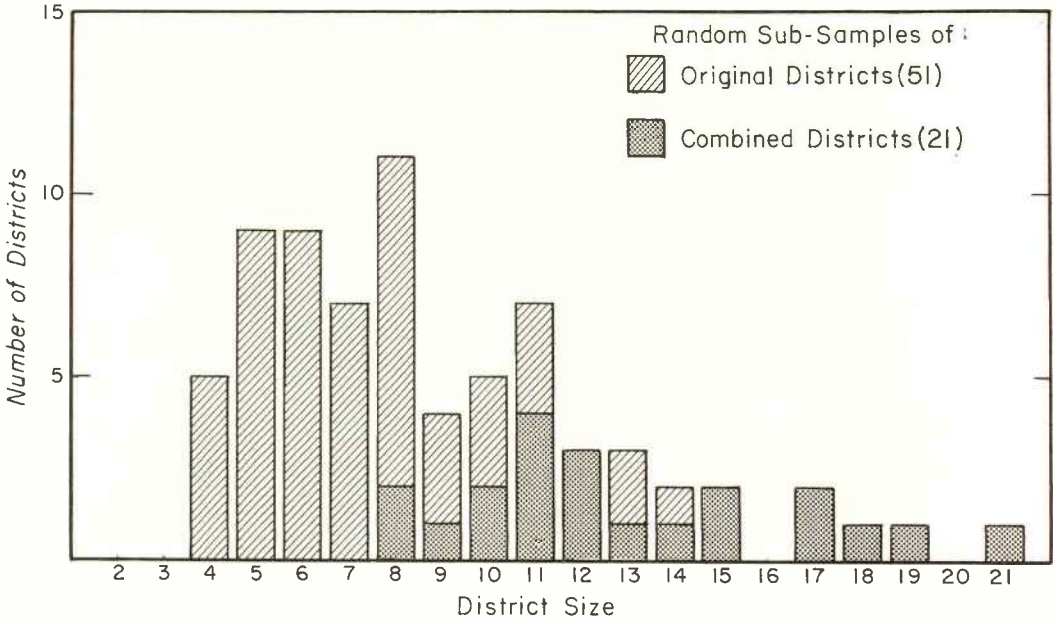


Figure 34. Distribution of sub-sample for District splits.

E. FIELD STUDY FINDINGS

During the field interview, reactions to the second questionnaire were many and varied. Field people often questioned if particular items validly measured effectiveness. They pointed out that there were often other good reasons why a District did not meet its planned timber cut, for instance, or did not make the planned number of range inspections. An oft-expressed opinion was that effective personnel--a good Ranger with a good staff--resulted in an effective District. This opinion was borne out by analysis of questionnaire data in which both managerial competence of the Ranger and technical competence of the Ranger and his staff were positively correlated with effectiveness measures and by the Comrey study. (4) When persons interviewed were questioned in detail and asked for specific suggestions for better ways to assess effectiveness in the study, they gave no usable suggestions.

Data from 20 Districts were analyzed, with the help of each Ranger. They showed that for these Districts, Rangers spent on the average 30% of their 1,800-hour work-year in the field. This ranged from a low of 18% to a high of 45%. No relationship was found between the size of Districts and the amount of time Rangers spent in the field.

Numbers of trips made by Rangers were more fully sampled in the simulation part of this study, so will not be discussed here.

An unsuccessful attempt was made to determine quantitatively what differences might exist in the kinds of work (managerial vs. production tasks) performed by Rangers when in the field on Districts of varying sizes and effectiveness ratings. Many of the Rangers interviewed, particularly those now on large Districts but with experience on smaller Districts, believed strongly that the type of work performed by the Ranger on a large District was heavily oriented toward planning, inspecting, coordinating, and over-all supervision. They also believed that the Ranger on small Districts was much more involved in the production aspects (marking timber, scaling logs, reading range transects, maintenance of improvements, etc.).

What is a desirable balance between managerial work and production tasks was explored in the interviews. The Rangers and others felt that District Rangers should spend about 20% of their time on production tasks. Evaluation of opinions was difficult in that the distinction between production and managerial tasks is not always clear. For instance, a Ranger's actual participation in work may result in output or production, but the output may be incidental to some other purpose closely connected to his managerial job. The field team felt that 10-12% of the Ranger's time is, in most instances, a sufficient allocation to production. Where this target is frequently exceeded, the Ranger should seriously question his time utilization.

If it is true, as opinions and observations indicate, that Rangers on small Districts become more involved in production tasks, a possible explanation is the lack of someone else to do the work and the need for the Ranger to fill out a part-time management job with useful though non-management work. If the role of the District Ranger is to be defined as primarily that of a manager, then insufficient managerial work to occupy the Ranger's time may be a good basis for enlarging the District.

A typical or uniform organizational pattern for Ranger Districts is difficult to set because of the wide differences in situations and the kind and amount of work that exists on different units. The span-of-control for the Ranger was studied on each of the 34 Districts visited in the field study. We found that it varied from a minimum of one to a maximum of six. Actually, the span-of-control appeared to be of minor importance because it can be expanded or contracted by either further division of functions or by grouping several functions under one staff man with a sub-structure. Thus two Districts with workloads similar as to amount and variety might have a span-of-control varying from as few as three to as many as six. This variation was found on Districts that were visited.

Opinions were solicited during the field interviews on the proper number of primary staff on a Ranger District. Primary staff in this study is considered to be those employees who report directly to the Ranger for supervision and who have significant responsibility and authority for planning and directing, and sometimes doing, a major segment of the resource management, protection or development job on the District. Lower grade-level employees who are primarily production workers, even though organizationally they may report to the Ranger, would not usually be considered primary staff. From the 232 individuals interviewed, there was a strong consensus that as a minimum, each Ranger should have a primary staff of three people. An optimum was considered to be four and a maximum five. This level of staffing was considered desirable to free the Ranger from the need to handle details of functional activities and to allow each staffman to develop and maintain expertness in his assigned field. It was emphasized that it is becoming increasingly difficult for a man to effectively handle more than one or two functional activities as management intensity and complexity of functional activities increase.

The ability of a Ranger to use his staff effectively appears to be related to the effectiveness of a District. Districts visited during the field study were generally not found to be effective unless the Ranger was able to delegate responsibility to his staff and accomplish much of his work through them. Where this did not occur, the staff was usually confused and uncertain, morale was low, and there was little evidence of teamwork. The effective use of the staff was more pronounced on the larger Districts partly because of the selection of the more competent administrators for the larger and more complex Districts, and partly because a large staff usually forces delegation. On very small Districts

(with one or two staffmen), the Ranger tends to retain all responsibility and decision-making and requires his subordinates to devote their time to work of lesser importance. This arrangement results in a less challenging environment and often creates a situation in which employees are content to maintain the "status quo" instead of developing new ideas. We do not mean to imply that all Rangers on large Districts use their staffs effectively or that all Rangers on small Districts do not. But we found enough situations on large Districts in which staffs were not being effectively used so that corrective action is indicated. More intensive training in managerial skills for employees early in their careers should improve the situation. Careful selection of District Rangers for their managerial ability as well as technical competence should also help to insure a more effective District organization.

Where fewer than the minimum desirable number of staff exists on a District, an obvious way to increase staffing is to increase the District size by enough to justify at least the minimum staffing.

In some parts of the National Forest System, notably where the range management function is dominant, it would be difficult under present workload measurements and financing to increase District size enough to provide a minimum of three Ranger staff positions. To do so would tend to inflate the physical size (acres) to the point where a Ranger could no longer maintain reasonable familiarity with and control over his District. Some of these Districts may "grow" in size in the future by increasing intensity of resource management with accompanying increased budget and manning, but other Districts may not. For those Districts with low resource values per unit area and little potential for increased management intensity in the future, less than a desirable minimum staffing may need to be accepted or the decision made to subsidize them.

There may be opportunities on some Districts to increase Ranger District staffing by further decentralization from the Forest organizational level, or from zone positions. Jobs often done for the Districts are road maintenance, recreation area and site planning, mineral examination, land acquisition, part or all of timber sale appraisal work, range allotment analysis, and various engineering work, including some contract administration. In the field study, various ways of handling these jobs were observed and discussed. Each situation while conforming generally to national guidelines was partly the result of the particular organizational philosophy that prevailed in that area, and of course, depended on the volume and stability of work that existed at the District level. Considerable study has been given to the question of how best to organize to get various jobs done.

A recent Forest Service study of the engineering organization was made by the Division of Administrative Management in Washington, under the direction of R. Max Peterson. The study supports the existing engineering organization philosophy which decentralizes the professional

engineering talent at Regional and Forest levels but not below except for rare exceptions. Most of the existing deviations from this general rule were found in Region 6 (Oregon and Washington) and to some extent in Region 5 (California) where the large timber volumes and attendant road construction work had resulted in placing engineers at the Ranger District level. At the time of the field visits, Region 6 was pulling back some of its professional engineers to the Forest Supervisor's office and replacing them with engineering technicians.

There will be considerable variation in how far highly specialized tasks can be decentralized to Ranger Districts because of the wide variation in situations throughout the Service. But guidelines should be made more specific at the national level and then modified as needed locally. The most important considerations in application appear to be volume and stability of the jobs to be done.

One nearly universal appeal from Rangers was for relief from paperwork. Those who had an Administrative Assistant as a member of their staffs claimed considerable relief from report preparation, budgetary work, some planning, and other similar work that is normally beyond the responsibility assigned to District Clerks. Rangers often stated that if forced to make a choice, they would prefer to give up any other primary staff position before eliminating the Administrative Assistant job. This area appears to warrant further study to see if Administrative Assistant positions can and should be established on more than just a few of the biggest, best financed, and most intensively managed Districts.

Increased staffing of Ranger Districts could lead to greater delegation of authority to the District level. On heavy timber Districts, for instance, where a large, experienced and specialized timber staff existed, Rangers sometimes are delegated authority to sell larger volumes and values of timber products than in cases where the expertness is retained in the Forest Supervisor's office. There appeared to be opportunities and adequate justification for more delegation in other cases where it had not yet been done. It seems logical that the same thinking could be applied in other functional activities, on heavy range Districts, for instance, where authority for permit issuance could be increased at the District level. There is a tendency to delegate authority uniformly at each organizational level without regard to differing local organizational capabilities. Even without a large staff, a District Ranger with only one or two primary functional activities might well be able to maintain a capability to handle increased delegation in his main activities. Further study of delegation seems warranted.

Information was not obtained in this study that shows any one organizational pattern was superior to any other. If increased staffing of Ranger Districts should become a strong management objective, however, there appears to be some opportunities to accomplish this through further decentralization.

During the field interviews, opinions were solicited about desirable period of tenure in District Ranger and District staff positions. For Rangers, most people believed that the minimum tenure should be 3 or 4 years, optimum tenure should be about 5 years, and 8 to 10 years should be a maximum. For District professional staff positions, the minimum desirable tenure was most often thought to be 2 years, the optimum 3 years, and the maximum 4 years.

During periods of expanding programs, it has often been impossible to attain even the minimums in some areas of the National Forest System, but the figures listed above were considered by respondents to be desirable goals.

Employee development and career ladders are closely tied to considerations of tenure. There was no clear consensus from the field interviews as to the best way to develop potential District Rangers. Some people preferred experience and training in District staff positions, then as Ranger on a light workload (GS-11) District and then transfer as Ranger to a heavier (GS-12) District. Others felt staff experience in more depth, including assignment to a GS-11 staff position on a heavy District, would best equip a Ranger to take over the complexities of a GS-12 District, with Ranger experience at the GS-11 level not necessary. As with many of the other questions explored in the field interviews, the personal experience of the respondent weighed heavily in forming his opinion. It seems reasonable that each of the above alternatives may be appropriate, depending on the individual and the circumstances.

Opinions about maximum tenure of Rangers were often expressed with reluctance. Each person could think of situations in which Rangers appear to still be quite effective after spending much more than 8-10 years on the same District. Still, there was a general feeling that a Ranger should not be left on the same District indefinitely. Comrey, et al 2/ found that effectiveness of a National Forest organization was negatively correlated with the Forest Supervisor's length of tenure.

The relatively short recommended tenure of Ranger staff personnel was based on the feeling of need to provide breadth of experience without holding employees in the lower-grade positions too long. Experience on at least two different Districts, and preferably more, was considered important. The fairly rapid turnover of staff that would result was mentioned as a disadvantage to the Ranger in that it increased his time spent training new people. This training consideration was important in influencing the selection of five as the maximum size of the Ranger's primary staff.

The idea that there are opportunities for careers in either line or staff with an interchange between the two avenues not essential has been

---

2/ A. L. Comrey, Pfiffner, J. M. and Beam, H. P., Factors influencing organizational effectiveness, I. The U. S. Forest Survey. Personnel Psychology, 5 (4), 307, 1952

widely expressed in the Forest Service. But the traditional weaving back and forth in career ladders still appears, from the field observations and interviews, to be a firmly held idea. Some exceptions were noted, but generally every young professional forester is considered (and considers himself) a potential District Ranger. There may be advantages to recognizing earlier in the careers of young professionals their preferences or limitations or both in line or staff career goals.

Acreage was discussed during the field interviews as a possible District size criteria. Most of the people interviewed agreed that within reasonable limits, the intensity and complexity of management is much more important than the number of acres. We found a consistent difference in what was considered "reasonable limits" for acreage, according to where the person was stationed. In the East and Southeast, 150,000 acres was thought to be about the maximum area that a Ranger District should cover. This conclusion is understandable in that good road access, numbers of users, intensively developed resources, complex land patterns, and other similar factors generally will build up a medium to large workload on a District with that area or less.

In the West, up to about 500,000 acres was considered acceptable. There are, of course, many Districts larger than this. But usually they contain large areas of wilderness, minor resource values per unit area, or inaccessible and undeveloped resources. Another consideration in thinking about a maximum area size is the cost in time and money to merely travel around the area. There was a strong feeling, as previously stated, that a Ranger must be able to maintain a current knowledge of his District in order to redeem his responsibility. To do this, he must actually see all of it with reasonable frequency. Naturally, the more area he must cover, the more difficult this becomes.

The specific subject of travel time was discussed with people in the field. Again there was a geographic split along the same lines as acres discussed above. The question about travel time was framed in relation to the time taken to travel to major work areas. In the East, 3/4 to 1 hour was considered the maximum beyond which over-all management suffered. A corresponding figure for the West was 1 to 1-1/2 hours.

During the study, efforts were made to define further the role of the District Ranger. Since we were not able to develop objective measures for determining this role, it was necessary to rely on opinions expressed by those interviewed and on the field study team to interpret, accept and reject as seemed appropriate, and finally express a summary opinion.

In this summary, the Ranger emerges as primarily a manager with a staff of at least three assistants. Ideally, not more than 10% of his time should be spent on production tasks, often done incidental to his management job. The balance of his time (90%) should be managerial

work, which includes supervision and training of people, appraisal of resource management, development of protection needs, and contacts with the various "publics" on his District. This time balance may be difficult to achieve on Districts that are toward the lower end of the recommended optimum size range, but is a desirable goal even on the smaller Districts.

A Ranger should spend about 30-40% of his time in the field on his District. Here also, the same balance of 90% management and 10% production should be the goal. His District should be large enough to support a staff of the recommended size, but should not be so large that, considering time spent traveling, he cannot have at least a general first-hand knowledge of his District and the situations about which he has to make decisions.

Before becoming a Ranger, his training should include sub-Ranger assignments on at least two other Districts and experience with several functional activities to give him adequate breadth of experience needed to meet the responsibilities and authority he will have as a Ranger. For the heavier Districts (GS-12), either more responsible staff experience or assignment as a GS-11 Ranger can adequately prepare him for the job. He should remain on a particular District as Ranger for at least 3 years, so as to learn the District well enough to make a significant contribution to the job and to gain a reasonable amount of experience to further his personal development for more difficult and responsible future assignments. After 8-10 years, a Ranger should be moved unless there are good reasons in particular cases for not doing so. This move is usually beneficial to management in providing fresh, new, and often improved approaches to management problems.

The above composite picture will have local variations in practice because of the great variety of situations on the National Forests. But it expresses the principles and establishes the pattern toward which management should work.

To illustrate this variety of situations, a tabulation of District characteristics, roughly by geographic areas, is given below:

a. Timber Districts -- West and Northwest:

(1) Large area: 200,000 - 600,000 acres

(2) Big budgets: $200,000 - $400,000

(3) Large staff: 4-6 primary staff

(4) Understructure of professional employees

(5) Low to moderate complexity (population, private land, MU coordination, and number of counties).

b. Timber Districts -- East, Northeast, Southeast

(1) Small Area: 50,000 - 100,000 acres

(2) Small budgets: $50,000 - $100,000

(3) Small to moderate staff: 1-3 primary staff

(4) Understructure of non-professional employees

(5) Moderate to high in complexity

c. Recreation Districts -- all areas

(1) Often small area: 50,000 - 100,000 acres

(2) Budget moderate to large: $100,000 - $400,000

(3) Small to moderate staff: 1-3 primary staff

(4) Fire protection often a major job

(5) Watershed management often a major activity

(6) People pressures heavy

d. Range Districts -- Great Basin and Southwest

(1) Often large area: 300,000 - 900,000 acres

(2) Small budget

(3) Small staff

(4) Little or no understructure of professional employees

(5) Mostly base work (little project)

(6) Sparse population but users heavily dependent on range resource

The foregoing tabulations are generalized characteristics. Each Ranger District is slightly different from all the rest. Each must be tuned to the desires, customs, and traditions of the local people, communities, and situations as well as be responsive to national objectives and policies. These great differences across the country make it difficult to prescribe policies and procedures that will fit everywhere and still not be so general as to provide no real direction at all.

A few situations are described below as illustrations of some of the kinds of problems observed during the field visits.

In the Southeast, there are and have been for years a large number of forest-workers employed on Ranger Districts to do project work. Their large numbers and dependence on these jobs dictates that the local public interest is best served by continuing to do much of the Forest Service work directly with employees rather than by contracting. On some of the National Forests in the Southeast, these employees are unionized. This collective voice makes a strong point in opposition to contracting. A conflict exists in that national emphasis is on increased contracting and reduction of the numbers of Federal employees. Local management is faced with resolving or at least minimizing this conflict between pressures for contracting and pressures to maintain local employment opportunities.

To look at another situation, in much of the Great Basin and parts of the Southwest, the local economy is based on grazing. Grazing use often predates the establishment of the National Forests in the area. Many of the permittees are small ranchers, barely subsisting by use of Forest ranges, but tenaciously holding on to their homes and permitted range. Traditionally, Ranger Districts in these areas have been staffed with just a Ranger or a Ranger and one or two assistants. The Ranger has always personally handled most of the range job on these Districts, particularly contacts with permittees. This personal contact need not be continued, for according to field opinions and observations, competent Ranger staff personnel can, and in some instances do, handle 80-90% of the job. Some local resistance by permittees to dealing with anyone but the Ranger and a deeply intrenched in-Service feeling about how these Districts should be organized and administered will make any immediate or drastic change difficult to accomplish.

Throughout the Service, isolated parcels of National Forest land present problems. Sometimes these are so widely separated from other National Forest land that Districts (and sometimes Forests) have to be either too small or too large from the standpoint of an optimum organization and most efficient management. Over the long run, these problems can be solved by disposal or acquisition of more land or both. In the meantime, these exceptions must be recognized and administration of these units continued as at present.

An extremely fragmented land pattern is typical of much of the East and Southeast. This condition is due to the inability to follow through on land acquisition plans when the Forests were being acquired during the 1930's. While this land pattern complicates management and increases costs, it by no means makes management impossible or necessarily ineffectual. To a person not familiar with this land pattern, which is usually further complicated by metes and bounds surveys, management would seem nearly impossible. But the local Forest Officers accept this as the way things are and make local adjustments in management procedures to accommodate this complexity.

Many more local situations were observed by the field team and discussed with field people. These discussions provided the team with a knowledge and understanding of management situations which was essential in appraising and assessing all study findings to assure their widest possible application to conditions as they actually exist on Ranger Districts.

LITERATURE CITED

(1) ADLER, E. P., "Relationship Between Organization Size and Efficiency, "Management Science, Volume 7, No. 1, October 1960.

(2) Anonymous, The Holy Bible, Book of Exodus, Ch. 18, n.d.

(3) CAPLAW, THEODORE, "Organization Size," Administrative Science Quarterly, Volume 1, No. 4, March 1957.

(4) COMREY, A. L., PFIFFNER, J. M. and HIGH, W., "Factors Influencing Organizational Effectiveness, V. A Survey of District Rangers," Personnel Psychology, Volume 7, No. 4, Winter 1954.

(5) CYERT, R. M. and MARCH, J. G., "Organizational Design," in New Perspectives on Organization Research, W. W. Cooper, H. J. Leavitt and M. W. Shelley II, (editors), John Wiley & Sons, New York, 1964.

(6) DAVIS, L. E. and VALFER, E. S., "Studies in Supervisor Job Design," Human Relations, Volume 19, No. 4, 1966.

(7) GRAICUNAS, V. A., "Relationships in Organizations," in Papers on Sciences of Administration, J. Gulick and L. Urwick, (editors), Columbia University Press, New York, 1947.

(8) JACQUES, ELLIOTT, Time Span Handbook, Basic Books Co., New York, 1965.

(9) JACQUES, ELLIOTT, "Too Many Management Levels," California Management Review, Volume 8, No. 1, Fall, 1965.

(10) KAHN, R. L., "Leadership Patterns and Organization Effectiveness," University of Michigan Survey Research Center Monograph, January, 1955.

(11) KENDALL, M. G., Rank Correlation Methods, Hafner Publishing Co., New York, 1955.

(12) LIKERT, RENSIS, "Measuring Organizational Performance," Harvard Business Review, Volume 36, No. 2, 1958.

(13) MAHONEY, T. A., "Unemployed Perceptions of Organizational Effectiveness," Management Science Quarterly, Volume 14, No. 2, October, 1967.

(14) NELSON, EDWARD A., "Management Theory and the Economic Size of Organization," Monograph SP 2605, System Development Corp., Santa Monica, October, 1966.

(15) SIMON, HERBERT A., Administrative Behavior, McMillian Co., New York, 1959.

(16) SUTERMEISTER, R. A., People and Productivity, McGraw-Hill Publication Co., New York, 1965.

(17) TRIANDIS, HARRY C., "Notes on the Design of Organization," in Approach to Organization Design, James D. Thompson, (editor), Pittsburg University Press, Pittsburg, 1966.

(18) URWICK, L., "The Managers Span of Control," Harvard Business Review, Volume 34, No. 3, May 1956.

(19) U. S. AIR FORCE, "Studies in Organizational Effectiveness," Air Force Office of Scientific Research, R. V. Bowers, (editor), 1962

(20) U. S. FOREST SERVICE, Forest Service Manual, Section 1243.52-1243.53, U. S. Government Printing Office, Washington, D. C., 1963.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1968 345-321 (FS-21)